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Discussion of all papers is invited

VOL. 14 OCTOBER, 1925 No. 4

BEAUTIFYING WATER WORKS PROPERTIES[1]

BY C. S. DENMAN[2]

The value and the actual necessity for public parks are everywhere recognized and need no argument. What better place for a park is there than the waterworks grounds? No matter how unfavorable the location it is susceptible of improvement and can often in a most striking and effective manner arouse the pride and interest of the people in their water works, which is of such vital importance to the community by making it an attractive place of resort.

This is also a matter of plain business sense. It is on the same principle that a farmer spends part of his time in planting trees and shrubbery and in raising a few flowers around his house. The capital expenditure and the cost of upkeep are justified. A city should not be a place primarily in which to do business, but a place in which to live and, to make it desirable, its institutions should be marks of beauty.

The plant and property of the Des Moines Water Company was acquired by purchase by the city of Des Moines in November, 1919. In January, 1920 the suction well which had served the city since 1882 suddenly failed and for a period of two weeks during the hours of heavy pumpage the higher portions of the city were without water.

[1] Presented before the Louisville Convention, April 28, 1925.

[2] General Manager, Des Moines Water Co., Des Moines, Ia.

The Water Board proceeded, without delay, to construct a new pumping station on the south side of the Raccoon River. This construction and the abandonment of the old plant had been urgently recommended by the Company's consulting engineers several years previously. The danger at the old plant had been apparent for some time, but the construction of the new station had been deferred owing to negotiations, which had been pending for a number of years for the sale of the property to the city.

The site of the new pumping station is on ground subject to overflow from the river close to the business district, located on a main highway leading into country and suburban areas which are rapidly developing. The elevation of the ground was about 112, water works datum, which was more than six feet below high water. The pumping station and grounds were designed to withstand floods which necessitated the grading and filling of the grounds and roadways, in the immediate vicinity, to an elevation of 120 or about an average of an eight foot fill. Deep borrow pits were dug and about 40,000 yards of earth, including that taken from the pump pits and suction well, were thus scooped up to bring the grounds and roadways to the desired elevation. To have hauled this yardage from a point outside the site would probably have cost about $60,000, but it was done at a cost of approximately 26 cents per yard, or $14,400, a gross saving of approximately $45,600.

Landscape architects were employed to make a comprehensive plan for the beautification of the grounds. This plan called for the puddling, with gumbo one foot in depth, the large borrow pit 700 feet long and 100 feet wide located immediately in front of the station. The gumbo was obtained at a nearby point adjacent to the river at a cost of $1478. Thus the unsightly hole in front of the plant was converted into a beautiful lagoon. To add to the effect, the banks were trimmed, sloped and planted with shrubbery, consisting principally of sumachs, willows, elders, dogwoods, viburnums, hawthorns, wild crabs, perennials and many others, most of which are native to Iowa, and most of which were raised in a nursery previously established on the water supply lands. The shores were also planted with various species of aquatic plants and the surface of the lagoon was dotted with planting of water lilies and lotus. It was then liberally stocked by the State Fish and Game Association with bass, pike, croppies, perch and blue gills. The supply, for maintaining a constant water level, comes from the waste water of the plant. It passes through the oil coolers to a

fountain, thence to the lagoon overflowing through a sewer into the river. This waste water enters the lagoon, from the fountain, over an artificially constructed waterfall.

The fountain, before mentioned, was the development of another borrow pit, smaller in size, about 100 feet by 140 feet, situated on the south side of the pumping station building. Here a concrete pool was constructed 60 by 80 feet with a depth of 4 feet at the ends and sloping to 6 feet at the center. Water lilies were planted about the frog statues which were cast and set on pedestals at the four corners of this pool. A supply of water was piped to these frogs and spouted out through their mouths. Constructed around the edge was an ornamental balustrade made of white cement, with a walkway of red Coffeyville paving bricks laid with white mortar joints. Nearby seats were constructed of white cement and borders made to outline the walk. The banks away from the walk were sloped up to the elevation of the roadways and planted with bush honeysuckle, climbing roses being used around the benches and bordering the steps. At the elevation of the roadways the four rounded corners were planted with poplars and junipers. A flight of wide steps was built from the roadways down to the level of the pool. This fountain, was stocked with about 1000 gold fish which had been raised in a fountain at the old station. The cost of this fountain was $8675.85 which included all the items of labor and materials namely, piping, plumbers' work, connecting up water supply, concrete work, ornamental concrete balustrade, frog statues, sidewalk and drains.

Macadam roadways, 20 feet in width, the depth of which being about 12 inches, were built through the grounds. The foundation for these roadways consisted of coarse stone on which was placed $\frac{3}{4}$-inch trap rock and a $1\frac{1}{4}$-inch surface of trap rock dust to fill the voids. The roadways have no curb, but have a sod border. They were thoroughly soaked with water, rolled with a heavy steam roller and covered with a deliquescent material, calcium chloride. These roads consist of 5182 square yards and cost $1.92 a yard or a total of $9912.68.

The pumping station grounds face West 21st Street, the station proper being located about 200 feet back from the street facing the lagoon. An ornamental iron fence was constructed a distance of 1368 feet along 21st Street. Ornamental brick piers were placed every 48 feet to support the fence. These piers are of red faced brick with white cement joints, white cement base and caps.

Two ornamental swinging gates were hung on ornamental piers at the entrances of the grounds. The cost of the fence including piers and the gates was $4700.91.

South of the lagoon and lying along the street between the warehouse building and the cottages is a large garden bordered with shrubbery, containing sixty-two varieties of iris and twenty-seven varieties of peonies. This garden was laid out and planted with iris in the spring of 1924, the peonies being planted the following fall.

As already stated the excavation about the plant was essential to place it at a safe elevation. By utilizing the excavated areas with lagoon and other landscaping a thing of lasting beauty has been wrought out of what would otherwise have been wholly unsightly.

The water supply lands consist of approximately 450 acres contiguous to the Raccoon River, and have been farmed for a number of years by the water plant under a farm superintendent. In 1920 a nursery was established on these grounds and about 40,000 trees and shrubs were set out. There was purchased for this purpose what is known as lining out stock, at a cost of $2479.88, including the superintendence and planting. This nursery made a very rapid growth and since that time all of the planting that has been set out around the grounds has been obtained therefrom. The valuation of the stock in the nursery in the fall of 1924 was in excess of $10,000. The nursery was started and is being maintained with the idea of parking and beautifying all of the water supply grounds. The cost for the year 1924 for maintenance of the water works park, including the care of the nursery, was $4800. One man is employed the year round and during the summer season four helpers assist him.

Attention is called to the economy in the method adopted in the treatment of these grounds. The following is a summarized comparison of the cost of the two plans.

Cost of plan adopted		*Plan for filling*	
Grading from borrow pit.........	$14,400.00		
Puddling borrow pits for lagoon..	1,478.00		
Fountain........................	8,675.00		
Planting and nursery............	2,479.00		
	$27,032.00	Estimated	$60,000.00
			27,032.00
Saving by adoption of present plan..................			$33,000.00

To this saving should be added the value of present nursery stock.

In this park is located a group of dwellings consisting of one six-room cottage, one five-room cottage and one double house each of five rooms, all of which are rented and occupied by employees who are liable to be called out in emergencies. These cottages are modern in every respect and are located in the midst of beautiful surroundings.

The City of Des Moines is at this time retaining the services of one of the outstanding engineers of the nation in the preparation of a comprehensive city plan involving zoning as a part thereof. The beautification of the water works property represents only the coöperation by the water works trustees in the general plan undertaken in the beautification of the city. A water plant plays an intimate part in the social and economic life of every citizen. It is a community enterprise and should be treated as such. There should be the utmost coöperation on the part of all. Its problems are their problems. Every man is interested personally in its efficient operation. His health, as well as the protection of his property are vitally involved in a proper administration. There is nothing that the average citizen thinks so little about as long as he gets uninterrupted service at reasonable cost. This he has a right to expect as a matter of course. It is only when something happens which causes sickness, loss of property or interrupted service that he begins to think about it.

In theory all public business should be conducted with a sense of right, duty and honor as well as on lines of good judgment, selfish interest disregarded, and without the development of an autocratic spirit of control. This would be ideal. No political consideration should ever enter into the conduct of the business of a water works.

There has been some criticism from a political source of the parking and beautifying of the grounds of the Des Moines water works. Those who conduct such an enterprise should not object to any fair criticism from the public, but complaints are sometimes made without reflection or without any real basis of fact. Kindly, constructive criticism is rare. Unless there is something far beyond the outward evidence of handsome buildings, polished machinery, and beautiful surroundings, namely sound credit, the relations of the business to the public, its reputation and character in just and fair dealing, it is all in vain. Back up good looks by good character and remember "that the higher you climb in the world the plainer people can see you."

What is there to be gained by beautifying a water works? If it is a waste, it is not justified and should be condemned. A water plant is peculiarly adapted to beautification both from a practical as well as an asthetic standpoint. There is an appropriateness due to the nature of the business. The grounds and buildings are about all that are apparent to the eye, because 75 per cent of the value of the property is buried. It is obvious that beautiful surroundings add enormously to the value of the plant and especially is this true in the eyes of the public.

The beautification of the grounds shows tangible evidence of prosperity and cleanliness, even though clothes do not make the man, but as Lorimer says "they make all that you can see of him except his hands and face during business hours and that's a considerable area of the human animal." Disease and bad morals are most frequently bred in filthy surroundings. A dirty and ill-kept water plant should at once be under suspicion, not only as to the sanitary quality of its supply, but also as to the morals of its management.

Beautification has in it also a wonderful advertising feature both at home and abroad. Most people ardently love what is clean and beautiful. A feeling of beauty in its highest sense is undoubtedly a gift, but who shall say that it is not often unexpectedly latent and but needs development. It is recognized that the opening of many private gardens for public inspection will go a long way to develop a general desire on the part of every home owner to do something to make his home more attractive. The desire to do something of the same kind, even in a modest way, makes for better character and better citizenship. Beautification will make a water works something more than a mere power plant, a place of machines, too often a "desert of hideousness." I do not see why this should not be done. It will foster good will, fair dealing, confidence and win the praise of the people.

ENTRANCE TO FOUNTAIN F

OUNTAIN FROM ROADWAY

LAGOON, MACHINE SHOPS

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SOUTH ENTRANCE TO

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EXPERIENCES WITH SMALL SERVICE PIPES[1]

By J. E. Gibson[2]

The service pipes of a distribution system may be compared to the ganglia nerves of the human body. This is easily demonstrated when something happens to the consumer's supply line, for the difficulty or trouble is at once telephoned to the superintendent or manager at the office, with a very direct and explicit command that the matter be remedied at once. You may also compare them with the fiber root tendrils of a growing tree, for if the water department does not put out these tendril services the revenue with which to operate will be negligible.

In Wellington Donaldson's paper,[3] presented at the New York meeting as a contribution to the work of Committee No. 10 on Standardization of Services, he fully covered the action of water on service pipes. It is not my intention, therefore, to go into this phase of service pipe troubles to any great extent, but rather to put before you a plea for better service pipes, and my efforts and experiences in eliminating the mechanical difficulties with our service pipes at Charleston, South Carolina.

We, in the water works business, have no corresponding code to that of the National Electric Light Association and the Underwriters Association for the electrical installation and wiring of buildings. It is true we have a plumbing code and ordinances in most cities and towns, but these codes usually consider the drainage plumbing only. This is probably due to the fact that water can do very little damage should it run amuck in the building. Defective wiring may cause death and total destruction of the property, whereas the damage from water is usually limited to ruined papering and falling plaster. This, nevertheless, should be no excuse or reason for continuing our present practice of indifferent service pipe installation.

[1] Presented before the Louisville Convention, April 29, 1925.

[2] Manager and Engineer, Water Department, Charleston, S. C.

[3] Journal, May, 1924, page 649.

When water companies first came into existence the water works men insisted upon the consumer's plumber furnishing service pipe and laying it to the main in the street, the water department reserving to itself the right to tap its main and for which it charged a small fee. Naturally the plumber, in his desire for profit, furnished the cheapest material with which he could get away under the contract. The water department, to a certain degree, had the same motive in that they desired consumers; and probably they reasoned that it was best not to insist upon a too rigid inspection. These desires probably explain the past haphazard type of service now so common.

The cost of maintaining this class of service in the early days was relatively small. Paved streets were unknown, except in the most progressive cities, and when leaks occurrred they soon found their way to the surface of the ground as there were no underground structures—sewers, conduits and drains— to carry the leaking water away. In this day of modern pavements with a multiplicity of sub-surface structures, sewers, drains, conduits, etc., the cost of locating and repairing leaks in our small service pipes compels us to pay attention to and adopt a much higher class of construction, both as to material and workmanship.

We also suffer from another difficulty, due to having "grown like Topsy" without restraint or training, in that one consumer applies for an inch service, and another consumer thinks he must have an inch and a half service, although his demands and requirements may be less than those of the first. Fortunately, however, in more recent times we have realized our mistakes and have adopted a service charge based upon the size of the meter or tap and this has corrected, to a greater or less extent, the desires of the consumer for an impractical size service pipe.

We feel that it is the duty of the water department to adopt a smaller size of service pipe for residential properties, and to advise with the architects and builders as to what is the proper size of service pipe to give them satisfactory service. It has been our experience that this phase of building construction is often left to guess rather than to scientific design or thought, with the result that the owner often finds himself without adequate water supply or with a high minimum charge.

We have at present galvanized iron or steel; galvanized iron or steel lead lined; galvanized iron or steel cement lined; lead pipe throughout; lead tin lined and tin throughout; copper; brass and

cast iron service pipes, all with or without lead goosenecks as the custom in each locality may dictate.

Usually all service pipes are attached to the mains by some form of brass or bronze corporation cock screwed into the main, and at the curb there is usually placed another cock for the control of the supply to the building or buildings without the necessity of going to the street main. In all cases where service pipes with lead goosenecks are used the custom, to within the past ten years, has been to use a wiped joint, the ends of the gooseneck being furnished with a brass or bronze nipple for connecting to the galvanized or steel service pipe. During the past ten years, however, there has been developed a bronze lead to iron flanged coupling where the lead pipe is flanged out, forming a seat in the union of the coupling; and the iron or steel pipe is screwed into the opposite end of this union coupling. Where lead pipe is used throughout the service, the connection to the corporation cock and the curb cock has been made with either a wiped joint or lead flanged coupling. This method of connection applies to all of the types of service pipes enumerated above wherever goosenecks are used. In cases where goosenecks have not been used, it has been the custom to use some form of swivel joint screwed thread fitting to take care of any settlement in the main or service pipe so as not to pull out or break off the corporation cock.

Recently there had been developed a soft brass and copper service pipe, using standard wrought iron pipe threads and fittings. There has also been developed a soft copper pipe using a flanged bronze coupling without threads, the joints being made in a similar manner to those of the lead flanged coupling above referred to. I have had no experience with either of these latter type services and, therefore, in the following remarks you will understand that I refer principally to galvanized iron or steel services with lead goosenecks or to all lead services. I do not want you to feel that I believe that any type of service pipe can be used universally throughout our country. The local conditions as to soil, water or paving will have to be considered, but I do want to stress upon you the importance of the service pipe, and the necessity of giving it in the future more attention than we have given it in the past.

Some water departments make only the tap, depending upon the plumber to do all of the rest of the work. I am unalterably opposed to this method, and believe that the Courts have rightly condemned it. The water department, either private or city, is the only respon-

sible party and should be the only one permitted to open up the street or maintain property within the street limits. Therefore, I feel that the service pipe from the water department's main to the property line should be laid by the water department, who should have the entire responsibility as to its maintenance. I feel, however, that the first cost of installation of this service pipe should be borne by the consumer, unless the law and city ordinances are such as to permit the water department to make an annual frontage charge on all property where service pipes are installed, without regard as to whether the property is being used or not. My preference is to have the consumer pay the first cost of installation which acts as a perpetual bond of his intention to consume water of the department.

Let us now consider the service pipe, commencing at the main and extending through to the property line.

1. The tap or corporation cock: Should it be placed on top at 45° or 90° from the vertical? Condition and depth of main will probably govern, but I personally am in favor of about 45° from the vertical in that it gives a nice, easy operation of the tapping machine in installation and permits of an easy bend of the gooseneck away from the main. It gives ample opportunity for settlement of the main with a minimum likelihood of snapping off the corporation cock.

2. Should the corporation cock extend through the wall of the main? Some will say "no," but I am coming to believe that it is good practice to have this corporation cock extend through and into the main, possibly $\frac{1}{4}$ inch as a minimum. In our experiences at Charleston during the past three to four years, where we have had occasion to renew hundreds of service pipes, removing numbers of corporation cocks, we have found the tuberculation and rusting over of the opening in the main beyond the end of the corporation cock to such an extent as to reduce the opening to about $\frac{1}{8}$ inch in the case of a $\frac{3}{4}$ inch corporation cock; and in a few instances actually to close up the opening entirely. Had the cock extended into the main, say $\frac{1}{4}$ inch, I cannot conceive of this condition having occurred under any circumstances.

LEAD GOOSENECKS-WIPED JOINTS

Lead goosenecks with wiped joints have given satisfactory service in, by far, the majority of our cities, but occasionally we find that, due to soil conditions, wiped joints are not satisfactory. This is the case at Charleston where we have a low coastal peninsular,

with high saline ground water. There seems to be a galvanic action that soon destroys the amalgamation with the brass nipple so that the joint leaks, and it is our practice to use altogether a lead to iron union.

Probably 90 per cent of the water companies throughout the country use galvanized iron or steel pipe for their service lines, and in many cases there is little or not trouble. However, with filtered waters, low in alkalinity, or relatively high in carbonic acid, the results are not satisfactory. Considerable trouble from tuberculation and incrustation is had with the accompanying red water troubles. Galvanized iron or steel is admirable in one respect; that is, it is not easily injured by other operations in the street and will stand considerable abuse before being punctured, flattened or broken. In acid or saline soils galvanized iron or steel does not have a long life.

CURB COCK

We next come to the curb cock. Usually this gives relatively little trouble, particularly if it is the inverted key type, round way opening, but it does give trouble. It is primarily for the control of the water to the premise to avoid having to dig up the main to reach the corporation cock, and is for the exclusive use of the water department. This latter use, however, is not restricted, as the owner and plumber feel that they have a certain proprietary interest in it, and usually the troubles with the curb cock are due to these extraneous uses. Here again, we have the question as to whether the service pipe ends at the curb cock or extends to the property line. I think the service pipe properly should extend on to the property line. I understand that in some localities the curb cock is put at the property line rather than at the curb line. Our practice at Charleston, however, is to put it at the curb line.

METERS

It is, I believe, becoming almost the universal practice in the South, where frost is not severe, to place the meters at the sidewalk, either at the curb line or just inside of the property line. In the North, where frost extends downwards several feet, this is not possible or desirable; but the practice certainly does lend itself to easy reading, inspection and maintenance of meters, as you are relieved of all delays due to absence of owners or tenants of properties. At

Charleston, it is our practice to set the meter in the service pipe immediately behind the curb cock. We use a $7\frac{1}{2}$ inch cast iron brass meter coupling which permits sufficient space between the meter and curb cock to allow for the setting of the meter box. The meter is set about 15 inches below the surface of the ground, and we have yet to experience a frozen meter where the meter was actually in contact with the ground at the bottom of the meter box.

LEAD SERVICE PIPES

Lead as a material for water conduits has been known and used as long as any other material; in fact, we know that the earliest Roman water supplies used lead pipe for conduits and, therefore, under normal conditions there can be no objection to lead for service pipes. Mechanically, the objection is that lead services are easily injured by other operations in the street, such as being flattened or pierced by picks and shovels and, where there is a saline soil and wiped joints are used, galvanic action may occur that weakens the wiped joint. Chemically, some waters attack the lead and dissolve it, in which case, of course, lead poisoning may result. I have in mind a case in South Carolina where the water supply was from deep wells very low in carbonates and relatively high in carbonic acid, where the lead was dissolved more or less rapidly; particularly on service pipes where the water was being used regularly. This condition was corrected, and the entire trouble relieved by the use of a very small amount of soda ash in the receiving well from the pumps.

Lead has so many advantages that it forms, to my mind, the most acceptable material for service pipes. It is non-corrosive from acids in the soil, does not incrustate or tuberculate, is easily manipulated, can be bent to easy curves around obstructions, such as sewers, drains and conduits and when installed by competent workmen gives no trouble at all. Further, if it becomes necessary at any time to remove the service and install a larger one the old material has a high salvage value, which is not the case with any of the other materials now being used.

LEAD, TIN LINED, SERVICE PIPES

I have had no experience with this class of service pipe material, but I judge that it has about the same mechanical difficulties as the regular all lead. Chemically, however, it offers greater resisting

qualities to the corrosive action of the water, and the danger of lead poisoning is practically removed.

LEAD LINED GALVANIZED OR STEEL SERVICE PIPES

This composite material combines the many advantages of the two metals, the galvanized iron or steel protecting the thin walled lead pipe from mechanical injury, and the lead lining, in its turn, protecting the galvanized iron from internal corrosion. The danger from lead poisoning with certain waters is still present. It is installed the same as standard galvanized pipe, except slightly greater care is required not to injure the lead lining. Fittings are furnished with lead lining so that when the joints are made up the interior presents a continuous lead surface.

In soils that attack the galvanized iron or steel pipe, it offers no advantages over ordinary galvanized iron pipe. The jacket or iron casing is eaten away and the lead lining, being too thin to withstand the pressure, bursts. It has no salvage value such as the all lead service on account of the difficulty of removing the lead.

LEAD LINED, TINNED, GALVANIZED IRON AND STEEL SERVICE PIPES

No general remarks are necessary as to this material other than to say that it combines the several advantages of the individual composites.

GALVANIZED IRON, CEMENT LINED, SERVICE PIPES

I have had no experience with this material, but I can see that it has many advantages and where the soil is such as not to attack the galvanized iron, I would think it would be ideal, as my experience with cement lined cast iron pipe and thin walled wrought iron pipe has been very satisfactory indeed. Tuberculation or incrustation does not take place, and the carrying capacity is maintained indefinitely.

I should think it would require great skill in installation and would not be susceptible to bending to any great extent. To make it satisfactory, fittings should also be cement lined.

BRASS SERVICE PIPES

Brass or bronze has been known and used for ages in the manufacture of cooking and distilling vessels and for containers of liquids. It is particularly resistant to action of water and was used for steam

pipes, boiler tubes and heater tubes almost universally in the early steam days, both in land and sea service. It is still used, almost without exception, for condenser and heater tubes.

The economical and commercial developments of mining and manufacturing copper have so reduced the price as to bring this material within reach of competition with iron and lead pipe for services. Within the past few years there has been placed upon the market a semi-annealed and soft brass pipe, in iron pipe sizes, that can be cut and threaded with standard iron pipe tools. This pipe has many advantages. It combines all of the admirable features of the iron pipe, being easily cut, threaded and installed, having freedom from mechanical injury from other operations in the street and being practically free from incrustation or tuberculation, and chemically resistant to corrosion, except under conditions that are not often encountered in water service.

I have had no experience with this type of service pipe but the objections, as I see them, are:

1. Lead goosenecks will have to be retained.
2. Mechanically, unless the pipe is well annealed, it will probably open up or split along the seam. This is probably the most serious objection, from my viewpoint, as my experience with brass nipples has been very disappointing; so much so that we insist upon only cast brass nipples being used upon our service pipes and connections. (I recall an office building in Philadelphia with plumbing throughout of brass pipe, and a most excellent job. However, split pipes were not an unusual occurrence fifteen years after the completion of the building.)
3. Greater care will have to be used to secure good threads to avoid leaks as our enemy, rust, will not step in and make rust joints for us when we use this material.

COPPER SERVICE PIPES

About the time that the iron pipe size, semi-annealed or soft brass or bronze pipe was brought out, there was also placed upon the market a light gauge copper service pipe. This pipe comes in various lengths, the longest being 20 feet, and the joints are made by flanging out the ends of the tubing and using a collar, spherical union very similar in design to the well known iron pipe to lead flanged coupling.

Again, I must plead ignorance of having had any actual experience with this material other than that of making a joint at one of our state conventions. Undoubtedly, this material has advantages over all of the service pipe heretofore enumerated and has only a limited

number of their troubles. Briefly, its advantages may be stated as follows:

1. Soft copper, easily flanged and very flexible. It can be bent around obstructions.
2. Elimination of lead goosenecks.
3. Light in weight and easily handled.
4. No threading required to be done in the field. Flanging can be done with small anvil and sledge so that unskilled workmen can make a joint.
5. All thread cutting and fitting done on special parts and furnished in the form of fittings.
6. No jointing compounds or grease required as all joints depend upon compression of the soft copper between finished relatively hard bronze surfaces.
7. Tools required in the field reduced to a hacksaw and two monkey wrenches.
8. Uniform class of material throughout service, eliminating galvanic action between dissimilar metals.
9. Non-corrosive from external and internal conditions.

The objections are:

1. Lightness, or rather the thin wall permits of its easy collapse by a blow or from the weight of rock or dirt in backfilling.
2. Injury from other operations in the street.
3. Probably less salvage value in case of replacement.

None of these materials in themselves will cure the red water plague because the principal offender is the house plumbing, and the house will continue for a long time to be with iron pipe.

I can see no hope of getting entirely rid of the red water plague until we use some non-corrosive or rust-resisting, protective coating throughout the entire water works system, including the house plumbing.

The "proof of the pudding is in the eating," so in service pipes the material that gives the best results in your plant, under the existing conditions, is probably the proper one for you to use. There are other troubles, however, besides those of material.

WORKMANSHIP AND LABOR

The men entrusted with the installation of your service pipes should be thoroughly reliable, trustworthy and honest and should be instructed carefully as to how the work should be done, and under no circumstances should any work be covered up until inspected and tested.

Good tools and equipment should be furnished and maintained for their use. All pipe should be cut with a hacksaw rather than with a wheeled cutter, and if cut with the wheeled cutter the burr should be reamed out. My objection to the wheeled cutter is that it requires reaming afterwards and under stress or oversight this reaming is more often omitted than done.

LOCATION

The service pipes should, in all cases, enter the consumer's property from the front or street upon which the building faces and is numbered, without regard as to whether the building is situated upon a corner or not. This precaution is necessary to avoid confusion in records, and to enable the department to render quick service in case of necessity.

Driveways should be avoided on account of paving and annoyance in case repairs are necessary.

Other service ditches, such as sewers and drains, should be avoided. This is necessary to protect the service from injury due to other workmen working in the street. The drains and sewers are usually at a lower elevation, and if service pipes are laid in these same ditches settlement occurs which may break the water service pipe. Further, in case of repairs to other pipes at lower elevation, the service pipe must be supported and it is seldom, if ever, securely supported during repairs or protected and supported in backfilling. If leaks occur and they find their way to the drain, they may undermine the street surface should the drain be defective.

DEPTH

The frost line will probably dictate the depth to which service pipes are to be laid. The nature of the soil and type of paving will also have to be considered. The danger of injury from traffic is greatly reduced when the streets are paved, the critical period being that time during paving operations. The minimum depth, however, in our judgment, is fifteen inches below the subgrade of paving and twenty-four inches in unpaved areas. For cold climates the frost line will necessitate greater depths.

PLACING SERVICES IN ADVANCE OF PAVING

Put this phase of service pipes on the *"don't"* column as first and last items. It is an economic waste. Location and size are never

satisfactory. If paid by consumer it is always a sore spot, and, if paid by water department, it places an undue hazard in unprofitable investment and a perpetual menace in maintenance. Usually nine times out of ten, when finally required, there is something wrong, necessitating anyway opening up the street at the main. The capital and interest on this type of utopian investment, to save cutting open a new paving, would more than pay for repaving the streets, in many cities.

I realize that what I have said in the foregoing remarks presents nothing new, but rather a resumé of trouble existing or anticipated. I trust, however, that it offers something at which the members may shoot, and from such shooting I hope that Committee No. 10 on Standard Service Pipes may obtain valuable information for its report.

DISCUSSION

Wm. G. Schneider:[4] Mr. Gibson remarked that to install services of materials that did not rust would not in itself eliminate the red water nuisance. However, where brass or copper pipe is installed as the water service pipe and then brass pipe is used throughout the building no trouble from rusting of these pipes need be feared. Copper and brass do not rust and this fact is becoming more generally recognized the country over by plumbers, builders, contractors and home owners who are installing brass pipe plumbing extensively.

Another point brought out was that no piping material is a panacea for all difficulties being experienced. It is not my purpose here to say anything contrary to this statement, but from a corrosion stand-point, due to the inherent properties and qualities of copper brass, the statement can be made without qualifications that, under the same service conditions, brass or copper will prove superior the country over to all other commercial metals that might be used for water services, especially when we take into consideration all conditions as a whole.

About fifteen years ago when the use of the microscope was not as general as it is today the interior structure of brass pipe could not

[4] Research Department, Copper and Brass Research Association, New York, N. Y.

be studied. Brass pipe is finished by drawing operations which set up certain strains in the pipe plainly visible with a microscope. Such strains, left in the pipe years ago, occasionally caused brass pipe to split or "season crack." Nowadays all brass pipe is given an anneal to relieve these strains set up by the drawing operations and its structure is examined microscopically to be certain that all such strains are relieved. Brass pipe of today, as produced by good manufacturers, will not split or "season-crack."

Regarding the salvage value of piping materials, I should say that this is a subject that does not have to be considered very often where copper and brass are used, for these materials, installed as pipe, remain in service for many scores of years. The plumbing pipe, for instance, of the Parker House, Boston, Mass., was installed in 1857 and after sixty-eight years of continuous service is still going strong and has never had to be repaired. I think it will be found, if the Parker House in Boston is demolished, that the salvage value of the brass pipe will be very close to the value of new brass pipe today. Copper enjoys a salvage value probably higher than that enjoyed by any other metal. The salvage values of copper and brass are so high that we regularly read of salvaging operations on ships for no other purpose than to recover these metals. Probably the most extensive operation of this kind is the raising of the German Fleet sunk at Scapa Flow.

As to the strength of copper and brass pipe, I wish to point out that standard pipe size copper and brass pipe are tested under a pressure of 1000 pounds per square inch before they leave the mill. A 1-inch brass pipe will have an ultimate safe working pressure with a working factor of 6 of 750 pounds and a copper pipe about 560 pounds. As regards the strengths of these materials, they are more than strong enough and I would assure you that no failures of copper or brass pipe have ever occurred on this account.

The statement has been made, that it is a little more difficult to make tight joints with copper and brass, but I believe that some misunderstanding exists on this point. Copper and brass pipe are regularly being installed the country over and good plumbers have no difficulty whatsoever in making tight joints with these materials. The Copper and Brass Research Association, which I represent, has issued a book entitled "Practical Brass Pipe Plumbing" which may be obtained, for the asking, by anyone interested in this subject.

F. G. SMITH:[5] Mr. Gibson objects to brass pipe because some which he purchased years ago split lengthwise along a "seam."

It is doubtful whether that pipe was actually made with a seam. Brass pipe in standard pipe sizes has always been made seamless. Seamless brass pipe, unannealed, may split lengthwise giving the appearance of a seam, but if brass pipe is annealed it will not split.

This fact has been thoroughly understood for a number of years, so that brass pipe made today is not only carefully annealed but is also guaranteed against splitting.

Mr. Gibson also mentioned low salvage value of copper and brass as compared with lead. Copper and brass have a high salvage value at all times.

Mr. Gibson spoke of the advantages of copper and brass and in connection with resistance to corrosion stated that they were used for condenser tubes using sea-water. Copper is not used for this purpose. The brass commonly used is of a specific type known to resist corrosion of sea water better than copper. It is known as "Admiralty" alloy. However it is rarely made in standard pipe size, since it cannot be commercially made in sizes over $2\frac{1}{2}$ inches.

I should like to add that copper and brass properly used are superior in every way to other materials for small and medium sized service pipes.

C. R. HENDERSON:[6] Service pipes in Davenport, Iowa, are installed by and at the expense of the property owners.

Ordinances specify the material of which service pipes shall be made and require services to be laid from the main to the curb line in advance of the paving of any street. The soil is mostly clay.

About 50 per cent of services laid in advance of paving are ultimately useful, the others remain to leak and break and are some day discontinued.

All services within the roadway are required by law to be of lead, regardless of size of pipe. Lead flange, brass curb cocks and corporation cocks are used exclusively with lead pipe.

About fifteen years ago it was noted that many lead service pipes on the same side of certain streets ruptured, and it was noted that all services that broke along these streets came in close contact with a district steam main that was not well insulated. A report of this

[5] Technical Department, The American Brass Co., Waterbury, Conn.
[6] Manager, Davenport Water Co., Davenport, Iowa.

unusual condition was made to the American Water Works Association by T. N. Hooper. The theory advanced was that the service pipes and contents became hot during hours when no water was being used and that the water pressure stretched the walls of the pipe slightly until they became thin in course of time. Water pressure varies from 40 to 100 pounds and is increased at time of fire.

Double extra strong lead is used in important districts and for sizes above one inch diameter.

About 50 per cent of lead services above one inch diameter have ruptured, and it is now the practice to disregard the ordinance and lay genuine wrought iron, or cast iron pipe for sizes above one inch. In such cases brass branch connections are used at the main and one inch corporation cocks with one inch lead connections are used. A two inch service has three one inch cocks.

Lead services smaller than $\frac{3}{4}$ inch diameter have sometimes stopped up with a soft putty like substance. Little trouble has been had with $\frac{3}{4}$ and 1-inch lead pipe.

Before lead was used wrought steel pipe, galvanized, was customary and was short lived.

Above 3-inch nothing but cast iron pipe has been used and this material has been satisfactory.

The water supply is from the Mississippi River through mechanical filters with alumina coagulant.

The water works is operated by a public service corporation, the Davenport Water Company.

WATER RESOURCES OF CALIFORNIA[1]

By Paul Bailey[2]

In speaking of the waters of the state as a "resource," we think of them as a tangible asset, something definite existing in the mountains that can be used for domestic and irrigation supply, manufacturing, generation of power or other useful purposes. As engineers we have been accustomed in the past to discuss the waters in our streams largely on the basis of their summer flow. Interest has centered around the amount of water that can be diverted continuously throughout the season. The huge flood volumes that fill the channels immediately following storms have not, in the past, been included as a part of our water resources. Rather, they have been regarded largely as a menace to property and an expense to put under control.

The summer flow of our streams, however, is but the drain water in the wake of the season's floods, slowly working its way back to the ocean after the drenching of our mountainous areas by the winter's rains. These tardy waters have particular value in that they appear in the streams during the long dry summer season when water is most needed. Their total amount, however, is small, for three-fourths of the water flowing in California's streams, reaches the ocean within forty-five days after its precipitation upon the earth's surface. Following precipitation so closely, the bulk of the state's waters appears in the stream channels in fluctuating flows, having a striking similarity, in their varying magnitude, to the periodic occurrence of precipitation.

The stage to which the development of our state has arrived now forces the inclusion of these widely fluctuating and erratic flows in a statement of our water resources. With less than four million people in the state and only one-fourth of the lands that need water under irrigation, the entire summer flow of all accessible streams has been put to use. There are no additional waters that may be brought into service except these winter flows. Therefore, unless they are

[1] Presented before the California Section meeting, October 23, 1924.

[2] Deputy Chief of Division of Engineering and Irrigation, State Department of Public Works, California.

incorporated in a statement of the state's waters, our development is complete and future growth is arrested.

The 40 to 50 millions of people that have been variously estimated as being on the way to California, have no place in our vision of the future unless means are found of putting to use practically the entire volume of the state's waters. As these people arrive, the flood waters will become of greater importance for they constitute the bulk of the state's waters and practically all the waters that are not now put to use.

The *water* resources of California are therefore unlike other of the state's resources, the farming land, the minerals, and the raw materials of various kinds, etc., in that they have no fixed existence, but come and go with each rainy season. They are with us only for a brief period while making their way over the land surface from the high elevations upon which they are precipitated to the low elevation of the sea. In speaking of the state's waters as a resource, therefore, we refer to a swiftly moving substance whose quantity varies rapidly with the vicissitudes of the weather and which rushes down the stream channels after each storm to escape into the ocean.

In being so responsive to weather conditions, the volume of water available for future years is subject to the same inaccuracies of estimation as the prediction of rain. The only gage of what may be expected to occur in the future, is what has happened in the past. Although the oldest rainfall records in the state cover a period of seventy-five years, they contain little evidence of repeating cycles, but rather the seasons appear to succeed one another in permutations which contain values, the greatest of which is 4 to 6 times the least. The rainfall of the successive seasons take values varying from 0.4 of the long time mean to more than twice the mean. Fortunately, the fluctuation of each season is not uniform over the entire state, but, as one locality is low, another may be high, so that the average rain over the state does not vary between such wide limits as the rainfall in the several localities. Nevertheless, the records show the average for the entire state fluctuating between limits, the upper 3½ times the lower, with the individual seasons taking values at random between them. The records do not disclose what may be expected in the way of a succession of seasons of low values.

The uncertainty of estimating future stream flow based on past records is well illustrated in an examination of the statewide average of the rainfall records for the past fifty-three years. The last 8

seasons average 84 per cent of normal with three seasons of the 8 less than 75 per cent normal, and the last of the eight years only 48 per cent of normal. In the previous forty-five years, the lowest average for eight consecutive seasons was 91 per cent, and the lowest season was 56 per cent of normal. Thus, after experiencing forty-five years in which the longest period with an average as low as 84 per cent of normal was *five* years, and the lowest single season was 56 per cent of normal, there came a series of *eight* years averaging only 84 per cent of normal, with the last season 48 per cent of normal, 8 per cent lower than the most extreme season of the 45. Also, these consecutive eight years comprised three of less than 75 per cent normal, a frequency of 38 times in one-hundred years, whereas the average frequency for seasons less than 75 per cent normal, indicated by the forty-five-year record, is 18 times in one hundred years or only one-half that which actually occurred.

These figures are of especial interest right now at the close of the driest season, and also the driest cycle, of the fifty-three years compared, while many are wondering whether or not the climate is undergoing a change with diminution of rainfall. To say the least, they make the heart of a water-supply engineer sink wthin him for estimates of supply based upon the 45 seasons prior to 1916–1917 could never be fulfilled, nor anywhere near it, during the succeeding eight years.

This very dry period, coming at a time when the waters of the state are just in the beginning of their development, when only one-fourth of the land needing water is under irrigation and not more than one-fourth of the state's water are in use, has passed without serious consequences; but had the state reached a development in 1917, twice the actual, much of which development would be dependent on stored water, and had the works for storing water been designed on the basis of the previous 45 seasons of record, the past season would have witnessed a great calamity. The driest season of record would have started with reservoirs empty and continued with less than one-third of normal run-off to meet the demands for water.

The state is now entering upon a period where new development must be largely dependent upon stored water, and not more than one-fourth of its water resources have been put to use. To proceed much further, water from the wet years must be held over in storage for use in dry seasons, otherwise the limit established by the year 1923–1924, will be approached with less than one-third of the average

yield of the state's streams in use. Allowing a 50 per cent shortage in supply for such a year as 1923–1924, not more than half the state's waters can be put to use without over-year storage. The range of fluctuation of the run-off in our streams and the sequences of dry seasons in the groups of years, that should be used in designing storage works, needs to be given much greater attention in the future than has been necessary in the past. Where large populations are dependent upon over-year stored water for their existence, as will be the condition in this state in the coming years, it does not appear sufficient to design works for purposes where failure in supply will be serious, upon the basis of the sequences of the past fifty years, but, rather, they must be given more liberal dimensions to care for sequences of dry seasons worse than any now on the records.

The second most striking feature of the state's water resources, besides this variability in their seasonal volume, is their unequal geographic distribution. This unequal geographic distribution is important because of the expense of transporting large volumes of water for great distances. Without doing this, much of the state's agricultural lands must go unwatered. It is estimated that the 23,000,000 acres of farming lands in the state will require 46,000,000 acre feet annually to bring them to their maximum productivity. When we contemplate, that, based on the past fifty years, 58,000,000 acre feet would be the average yield from all the streams in the state, if unlimited storage facilities could be provided, the importance of the geographic distribution of the state's waters is at once apparent. The cost of the works for transporting water from areas of abundant supply to those of deficient supply, will determine the limit to which this state can develop. In the Water Resources Investigations of 1921–1923, it was found that 18,000,000 acres out of the 23,000,000 acres in the state could be irrigated within costs that future conditions might warrant. However, this can only be done by coördinating the source of supply and the place of use in all future developments, to the end that areas of deficient supply will export no water, and imports to areas that have a choice in supplies, will not rob other deficient areas of the only practical source for their importations.

How strictly these rules must be observed if California is to realize her dreams of the future, is evidenced by the fact that 72 per cent of all the state's waters are in the Sacramento drainage basin and the streams flowing into the Pacific Ocean north of San Francisco. But 27 per cent of the agricultural lands lie in these basins. It is the one

region of California in which surplus waters exist. In all other regions, the need for water to bring their agricultural lands to maximum productivity exceeds the available supply. The San Joaquin Valley has barely enough water for half its lands, while in the southeast corner of the state, diagonally opposite to the greatest of the water producing regions, the North Pacific Coast, lies the region of least water, one-fifth the entire area of the state, mountainous for a large part, but containing at least 4 million acres of flat lands of which the geography has only partly been recorded because of its extreme aridity.

In discussing the most advantageous use of the waters of all these regions, that for agriculture must be given primary consideration, because by far the largest quantities are needed for irrigation purposes. At the present time, domestic and industrial uses are only a twenty-fifth the amount required for the irrigation of the lands now using water. Water used in generating power and for operating mines takes place largely in the mountains at elevations higher than the agricultural lands. These waters are therefore largely available for re-use on the lower lying agricultural lands. The limitations to be placed on the transportation of water from one locality to another, therefore, should be closely related to the agricultural needs of adjacent territories.

The only surplus of water over local needs exists in the north, particularly in the North Pacific Coast Region, where three-eighths of all the state's waters flow to the ocean passing only 2 per cent of the agricultural lands. This is the one locality from which water can be exported without limiting the future development of the state's agricultural resources. The Sacramento Valley, in being adjacent to and unseparated from the San Joaquin Valley by mountain ranges, offers the logical source from which the deficiencies of the San Joaquin Valley can be supplied. Without importation into the Sacramento Valley from the North Pacific region, the waters of the Sacramento Valley are hardly more than sufficient to meet its own requirements and the deficiency of the San Joaquin area. In fact, to meet these requirements at costs that may be deemed reasonable in future years, water must be imported to the Sacramento Valley from the Trinity River, the most accessible of the Pacific Coast streams to the Great Central Valley.

These two prime characteristics of the state's water resources, the variable volume from year to year and the unequal geographic

distribution relative to the agricultural lands, here briefly described, are features that will undoubtedly guide the course of future water developments throughout the state. In order that the state's growth shall not be limited by shortages in water supply, it is fast becoming necessary that the various developments be coördinated so that these two characteristics of the available waters, their variability and unequal geographic distribution, will not prohibit the full use of the very limited water resources of the state.

STIMULATING ACTIVITY IN PLUMBING[1]

By Alfred W. Buschmann[2]

About twenty years ago we were conducting an ordinary grocery store. To this we added in succession, retail hardware, paints, electrical supplies, roofing, retail plumbing supplies, and then a plumbing contracting department.

In the grocery business we received sales help from jobbers and manufacturers by house to house distribution of samples, demonstrators in our store and plenty of general advertising of the lines we carried.

In the hardware business we were given practically the same help.

Our sales of electrical appliances were helped by the displays carried in the offices of light and heat companies, as well as the large amount of publicity they gave to the various slogans, such as, "Wash With Electricity," or "Let Electricity Do Your Work," and "Do It Electrically."

The gas companies displayed stoves, heaters, irons and other appliances and advertised "Cook with Gas," "Heat with Gas," and other slogans.

In the plumbing business we found that there was no help being given. The jobbers sold us the supplies and then forgot all about us.

Neither did we get help from the water company, as far as sales promotion was concerned. I do not remember seeing any water company advertise "Do It with Water," "Use More Water," or "Take More Baths."

Most plumbers considered a water company as a necessary evil and had their hammers out knocking its rules and methods of doing business.

In other words, it seems that everyone in the plumbing business was out for himself, not thinking of the other man at all. Coöperation seemed to be unknown.

In 1917, we went into the wholesale plumbing supply business and closed out all other lines.

[1] Presented before the Louisville Convention, May 1, 1925.

[2] President, August Buschmann and Sons, Inc., Indianapolis, Ind.

Our experience in the retail and contracting business gave us insight as to what the plumber needed in the way of service and assistance in procuring new business.

We started a lot of personal work with our customers. They were furnished with estimate sheets for figuring their work, sheets for keeping a record of the water company and city permits, time slips and many other convenient forms we had worked out as contractors. We also furnished them with a price service which was different from anything in use at that time.

They were encouraged to carry a larger stock and become retail dealers in plumbing supplies as well as contractors.

As our business increased, we realized that it would be impossible to keep up the close personal attention that we had been giving our customers so we started holding small and informal meetings in some of the small towns, inviting eight or ten contracting plumbers, giving them a good dinner and talking over business conditions in general, following up with concrete illustrations of how we had built our own business and what they could do with theirs. A few meetings of this kind proved to be profitable and we decided to try the same thing in Indianapolis.

We invited every plumber in the city—at that time there were about one hundred and fifty, representatives of the various utilities companies, the city engineer, the secretary of the board of health, and many others interested in the plumbing business, to a dinner and "get-together" meeting. At this meeting we stated that the object of the meeting was to create a feeling of friendliness and coöperation among those who were interested in the plumbing industry and to work out plans for coöperative advertising to impress on the public the necessity of more and better plumbing. At the present time we feel that we have accomplished very much along these lines.

Frank C. Jordan, Secretary of the Indianapolis Water Company, and now your ex-President, was one of the speakers. He stated that almost everything but plumbing work could be bought on deferred payments and suggested that a plan should be worked out whereby plumbing could be installed on a payment plan.

Our firm at once saw the advantages of a system of this kind and within a few weeks announced the "Buschmann Payment Plan" for the installation of plumbing.

No sooner did we announce the "Buschmann Payment Plan"

than howls and criticisms were heard from all sides. It had not been done before in the plumbing business so, of course, it was not considered practical or ethical by many of the older men and firms. Many of them predicted that the plan would be an absolute failure.

Now after three years, we are glad to say that, instead of a failure, it has been a decided success. The "Payment Plan" opened up an entirely new line of business. Many people who had never considered installing plumbing in their homes, got busy at once. We are safe in saying that a great many people who have bath rooms and modern kitchens in their homes would never have had them had it not been for the payment plan.

In fact, the money spent in working out the payment plan and advertising it, would have been well spent if not a single job had been sold on payments. The publicity derived from the advertising of the plan awakened many people to the fact that plumbing was not a luxury but a necessity and that the price of having a bath room installed was not as much as they had expected.

Since November, 1921, approximately five hundred jobs of plumbing have been installed in the City of Indianapolis on the payment plan and not one has shown a loss. About eighty plumbing firms are now doing work on the partial payment plan and from one to five jobs are going through our office every day.

On March 1, of this year, we started an active advertising campaign with which the plumbing contractors are tying up. We are placing several large bill boards each week. Advertisements are being carried in our three large papers, the Indianapolis News, Star, and Times, also in the Catholic Record, Jewish Chronicle, eleven neighborhood papers and two colored papers. All of the plumbers who are using the Buschmann Payment Plan display an attractive sign in their window.

We have, of course, made several changes and improvements in the original plan. As the system is now being operated, it is simple, requiring very little work on the part of the plumbing contractor.

In brief the plan is as follows, based on a job which figures $400.00:

The plumbing contractor figures his work in the regular way at $400.00 and adds 10 per cent ($40.00) for the "Buschmann Payment Plan" charges. His customer is then sent to our office to fill out a credit questionnaire. If customer's credit is found good, he signs a contract, pays our firm 20 per cent ($88.00) down and the plumbing contractor starts the work. As soon as the work is completed and

accepted by the customer, the plumbing contractor assigns his interest in the contract to us and we pay him the net amount of the contract ($400.00). The plumbing contractor's responsibility ends here. The customer then pays the remaining 80 per cent ($352.00) in ten equal payments ($35.20) at the bank designated in the contract.

When we originated the plan we had quite a hard time trying to interest bankers in the idea. Now we are being solicited by banks and finance companies who wish to handle the papers, one large institution having offered to take up to $100,000.00 worth.

At the present time we have four banks handling our papers. Our plan is to arrange with ten or twelve banks in various parts of the city so that the customers may make their payments where most convenient.

The "Buschmann Payment Plan" has not only increased the business of our firm, the plumbing contractors, and the Indianapolis Water Company, but has been of great benefit to hundreds of people. Many cases can be cited where homes, economic and health conditions, have been greatly improved through the use of our payment plan.

Several days ago we sold a job to a customer who stated that he had planned to install modern plumbing in his home for several years, but had not had enough cash at any time to pay cash for the job which figured $350.00. In checking up his credit we found that he was paying on a $700.00 player piano, had completed paying for a $150.00 radio, a gas range which cost $85.00, and various pieces of furniture. In other words, that which was most necessary in the home was pushed aside for nonessentials and luxuries because the man never had enough cash at any one time to pay for a good plumbing job.

Then we had a job for a colored waiter. He had a home partially paid for and wished to rent part of the home in order to help meet payments on the home. He had an offer from a school teacher and wife of $40.00 per month for three rooms on the second floor on condition that he would install a bath room. The work figured over $400.00 and he had only $100.00 saved up. He signed a contract using part of his $100.00 for the down payment and meeting the monthly payment with part of his added revenue from the rent of rooms to the teacher. Several months ago he completed his payments to us and is now paying off on his home at the rate of $75.00 per month instead of $35.00, which he formerly paid out of his wages.

At a meeting of the Indiana Sanitary and Water Supply Association in 1923, I suggested that water companies help stimulate interest in modern plumbing by having exhibits in their offices and lobbies. I am glad to say that the Indianapolis Water Company now has such an exhibit in their office. To the best of my knowledge they are the first water company in the country to do this. Quite a number of sales have been made by plumbers and ourselves through this exhibit, but the real advantage of the exhibit in my opinion, as far as the water company is concerned, is that it impresses on the public that the water company is interested in the improvement of health and home conditions as well as in the sale of water.

While I do not believe the water companies should actually try to install or back a payment plan for the installation of plumbing, they can be of real benefit to the community which they serve by promoting the idea.

DISCUSSION

Milton J. Ruark:[3] Mr. Buschmann's paper outlines a very desirable plan for financing plumbing work and encourages better living conditions and sanitation. The partial payment plan for plumbing work has been in operation in Baltimore for some time. About 1906 Baltimore was without any comprehensive sewerage system. There were approximately 90,000 cesspools serving houses in the city. The need for sewerage was very urgent and the Legislature authorized the appropriation of ten million dollars ($10,000,000) for the construction of a sewerage system, sewage pumping station and a sewage treatment works, together with a system of storm drains and appurtenances. The sewage treatment works was put in operation in 1911 and some lateral sewers (with connections to the property line) were provided for many of the houses served by cesspools, privies or private sewers discharging into city drains or the nearest water courses. As this system was extended, each property owner was notified by the Health Department to connect his dwelling or establishment to the sanitary system and to abandon the cesspool or other temporary arrangement. These regulations further required that the existing plumbing be altered and made to conform with a new plumbing code, requiring that all waste of a polluted

[3] Sewerage Engineer, Baltimore, Md.

nature be discharged into the sanitary system, and other non-polluted waste into the storm drainage system. Rain leaders discharging upon the surface were not required to be connected to either system, but the owner had the option to make connection to the storm water drain, providing one was available. These regulations were enforced in every instance, even where a building had previously been connected to a private sewer or public drain and the cost of rearranging the plumbing to conform to the new regulations was considerable. Plumbing work installed in the Baltimore Court House a few years before the present sewerage system was established was reconstructed, notwithstanding that the cost amounted to $6000. Similar large expenditures for altering the plumbing in schools and other buildings were required, but the City authorities felt that this action was warranted as the City would thereby set an example in establishing a uniform standard for modern plumbing.

In cases where the property owner failed to comply with the Health Department's notice within a reasonable time, the Health Commissioner, under Ordinance 58, was empowered to have the City Engineer do the work as a lien against the property. Usually, however, the property owner, if financially unable to have the work done, took advantage of the terms of Ordinance 58, which also permitted the owner to obtain a loan from the City and have the work done by a plumber of his own selection, making payment in five annual installments, as follows: (Assume cost of connecting to the City sewer and installing the necessary fixtures to be $250.00).

Plumber's estimate for plumbing	$250.00
City's overhead charge	5.00
Total cost	$255.00
1st annual payment $51.00 plus interest 6% for 1 year	54.06
2nd annual payment $51.00 plus interest 6% for 2 years	57.12
3rd annual payment $51.00 plus interest 6% for 3 years	60.18
4th annual payment $51.00 plus interest 6% for 4 years	63.24
5th annual payment $51.00 plus interest 6% for 5 years	66.30
Actual cost to property owner	$300.90

The rigid enforcement of the above mentioned regulations and the elimination of cesspools and the outside running traps, which were formerly permitted in Baltimore under the old plumbing code (still in use in many cities), have done much to improve sanitary conditions in Baltimore. Furthermore, sewer gas and explosions have been

eliminated. Notwithstanding that the reconstruction of the house plumbing and the cost of making sewer connections have involved a total expenditure to the property owners of eight or nine million dollars, and the cost of the sewerage system (sanitary and storm water) to date is over thirty million dollars, it has been clearly demonstrated that the benefits derived have justified this expenditure of public funds.

In addition to the opportunity for the property owner to make connection under the above mentioned ordinance, some owners have preferred to secure funds through building and loan associations or finance companies. The terms of Ordinance 58, however, are so attractive that only a small percentage of the owners borrowing funds for this purpose (perhaps 1 per cent or less), have preferred to obtain loans through other sources. In the older sections of the city where the houses did not have modern conveniences, the installation of plumbing fixtures has encouraged the property owner to install other improvements, such as gas and electricity. It appears that the property owners, after sewer connections are made, take more pride in their homes and have other minor work done, such as painting, renovating, and the removal of back yard fences, all of which tend to make a city a better place in which to live. The tendency to move from the older sections into the new or outlying areas is also retarded. The local gas and electric company has a similar partial payment plan for the installation of electric wiring, gas supply, gas and electric appliances, and it is possible for the property owners in Baltimore to obtain modern plumbing, gas and electric service through the partial payment plan. There is no doubt in the writer's mind that many of the residents now enjoy the benefits of these conveniences only because they are able to obtain them through the partial payment plan.

WATER PIPE LINE FAILURES

By Collins Wight[1]

It is often convenient to look at line failures as something entirely beyond our control—to regard them as just happening. We usually get away with it and in some cases we are correct. Definite analysis, however, usually indicates that all of the blame does not belong to the foundry and laboratory that made and tested the pipe. The most difficult thing to understand is the elapsed time, which may be hours, or even weeks, before the final rupture occurs.

In the past ten years, more than a hundred miles of pipe have been added to the Dayton system. Before that time there were no 20-inch mains a mile from the pumping station. Radical changes were necessary. Headers were installed better to control the lines from the pumps.

The breaks to be discussed cover every important failure. They do not include accidents in the river channels due to the work of the Miami Conservancy District which was unusual.

The most serious failure was an 8-inch connection off of two twenties. This was in front of the pump house and had seen thirty years of service, although the records were not clear as to the connection. A five foot fill in the street, as well as the complication of gradual building, made it essential that all connections be simplified.

The man in charge of the gang, a political appointee without previous water works experience, had the pipe uncovered, "To see how the connection was made." This was an extra piece of work just before noon on Saturday when he "Did not want to start any new work." At 12:50 p.m., this connection, with its bracing removed, broke loose. The water supply was off the entire low pressure district for ninety minutes. Five minutes after the line broke, the water was knee deep in the hollow between the station and the canal, which increased the difficulty of making a complicated shut-down.

A second bad break occurred during these same changes. A heavy

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rain loosened the temporary blocking on a 20-inch high pressure main. When the backing failed, the line went out.

A third joint blew on the high pressure eleven years after it went into service. This was a 12-inch plug in one end of a tee. It probably would have held had the line pressure stayed at 60 pounds. However the line was changed over to 150 pounds and the plug held for five years under this pressure.

A gravel plant, of the dead man drag type, was installed in the river near a high pressure line. Excavation was entirely removed under four lengths of pipe. Progress reports indicated that the line held for weeks in this condition until the bucket finally caught on the pipe and pulled the line apart.

Another joint on a 20-inch at a bend held for six years under low pressure and for four more years under high pressure. The small leakage which came first was sufficient warning to prevent serious trouble.

The 24-inch line to a reservoir broke at midnight, the line having been put in service late that afternoon. This was the worst break we have ever seen, a piece of pipe, diamond shaped, 26 inches wide and 70 inches long, breaking out. Before the line was shut off, 400 yards of gravel were washed out of the road, covering a car track that was needed in the morning.

A 36-inch main let go four days after it had been restored to service. It had seen four years continual operation before being shut down for a change at the pumping station.

A 24-inch high pressure main broke six days after some minor changes had been made at the pumping station.

A 16-inch main, formerly carried across an abandoned canal on concrete piers, had been in use for six years. When the canal was filled in, material was dumped in place by trucks. Part of the fill was foundation stones. Ten hours after the last load was dumped on the pipe, the line let loose, washing away a large part of the fill.

An 8-inch line had been under a mill race for twenty years. Three weeks after the fill was made, the line sheared off, probably due to settlement.

A 12-inch line was embedded in a concrete retaining wall without allowance for expansion. The pipe had been in place for twenty years, the wall certainly did not move, yet months after the wall was poured, the line sheared off, although on the side where the heavy fill had been made.

The cause of breaks is most interesting, though it is often complicated by the time element. Just how a piece of pipe can be damaged and yet not finally rupture for hours or weeks is hard to understand. Yet we can not get away from the fact, that careless handling, sometimes by water works employees, often by non-supervised outsiders, causes most of the trouble.

Air possibly causes more trouble than any other item. It is present whenever any part of the closed system is opened. In some plants, vacuum pumps are operated continuously to free the lines of air. The normal amount seldom causes trouble. Surges come from pockets and unusual conditions.

We recently inspected a large high pressure line after a serious failure had occurred. This line had been laid with a pocket several blocks long, and sharp grades at the ends. No provision had been made to relieve trapped air. Undoubtedly this was what caused the trouble.

One plant had a bottle tight sprinkler system. They were near enough the station to get the pulsations of the pump. Often their gauge, which we tested more than once, showed twice the line pressure. They had the most trouble with water hammer whenever the water ends of the pumps had been opened.

Too much care can not be taken in the design and operation of a water system to prevent hammer and surges. Our pipe will stand a very appreciable overload. Unfortunately the trouble does not come at once, although it usually comes when we violate plain laws which most of us understand, but which we do not always respect.

IODIN TREATMENT IN MICHIGAN[1]

By E. D. Rich[2]

By simple goiter is meant enlargement of the thyroid gland, without the symptoms of toxic poisoning. Simple enlargement of the thyroid most often appears at puberty, and is more common in females than males. Goiter is caused by a deficiency of iodin in the diet. Normally the thyroid gland stores up a quantity of iodin which by a not entirely understood physico-chemical reaction regulates the growth and activity of the gland. When an adequate quantity of this inhibitory substance is lacking goiter results.

The prevention of simple goiter is important for the following reasons:

1. Simple goiters sometimes grow large enough to be marked disfigurements and to interfere with respiration.

2. It has been found that simple goiter influences the succeeding generations. Dwarfs and other physical and mental defectives are more frequently found among the children of goiterous parents than among normal individuals.

Iodin has been used for the prevention and treatment of goiter for several hundred years. The early Greeks treated goiter by administering the ash of burned sea sponges, a substance rich in iodin. It has been stated that American Indians of the Northwestern United States chewed dried sea weeds, now known to contain iodin, for the relief of this disease. In each of these cases the useful element was of course not known.

The first carefully controlled experiment in the use of iodin for the treatment of goiter of which we find record was made by Marine and Lenhardt in 1907 when small amounts of iodin were added to water in an aquarium to prevent goiter in brook trout.

The area surrounding the Great Lakes has long been known as a section where goiter is a common affliction, but actual data showing

[1] Presented before the Central States Section meeting, December 5, 1924.

[2] Director, Bureau of Engineering, State Department of Health, Lansing, Mich.

the prevalence of the disease were not available until after the World War when records showing defects found in men examined for military service were published.

In the volume entitled "Defects Found in Drafted Men," published by the War Department in 1920, it will be observed that conditions in the northwest and in the Great Lakes region are most favorable for the development of goiter and that this region includes all of the Upper Peninsula and most of the Lower Peninsula of Michigan.

Results of the examination of the first two million drafted men in the United States show that in the State of Michigan for each 1000 men examined, 11.3 were affected with simple goiter and 7.01 had exophthalmic goiter. In nine counties of the Northern Peninsula of the state 25.62 of each 1000 had simple goiter and 9.36 had exopthalmic goiter. For each 1000 men 8.61 were rejected for military service because of this defect.

In 1917 Marine and Kimball began their study of goiter in the schools at Akron, Ohio, and during 1917–18–19 administered iodin to large groups of school children with very satisfactory results.

In 1921 a physician of Iron Mountain (a city in the Northern Peninsula of Michigan) who had apparently been following the work of Marine and Kimball proposed to the superintendent of water works of that city that iodin be added to the city water supply. The water superintendent referred the subject to the State Department of Health and after studying the literature available it was recommended that sodium or potassium iodid be added to the water supply at the rate of about 2 p.p.m. for a period of one week, twice a year. It was also recommended that before the water supply was treated a survey be made to learn the incidence of goiter in the city.

During the late months of 1921 a physician from the State Department of Health examined 2148 school children in the city and found 54 per cent affected with goiter. Early in 1922 a nurse from the Department collected data in the city to learn the incidence of goiter among persons above and under school age and to find if any noticeable variation in incidence appeared in persons of different nationalities. This study did not show any such difference and the total percentage affected in this group was approximately the same as among school children.

Of the school children examined 54 per cent showed thyroid enlargement to some degree. Of this 54 per cent or 1095 pupils,

72.4 per cent had slight enlargement, 24.7 per cent had marked enlargement, and 2.7 per cent had great enlargement.

The results of the work done by Marine and Kimball at Akron and the results of the survey at Iron Mountain attracted much attention throughout the state and many requests came to the department during 1922 from health organizations for assistance in making surveys to determine the incidence of goiter in different communities and for advice in the treatment of the affection.

As before mentioned, the records of drafted men showed a higher incidence of goiter in the northern section of the state than in the southern section and some northern sections had long been known as goiterous regions. The state as a whole offered an excellent opportunity for a systematic study of the relation of goiter to the amount of iodin available in food and water. For this reason in December, 1923, it was decided to make a comprehensive study of this relation. The first step was a survey of drinking water supplies of the state to determine their iodin content. Six or more 15-gallon samples of water from representative sources were collected and examined for iodin. The large samples and the use of the unit "parts per billion" instead of "parts per million" were necessary on account of the low iodin content.

From this water survey four counties were chosen for a goiter survey of school children, Houghton, with practically no iodin present in its drinking water, Wexford, with a slight trace, Midland, with a large amount, and Macomb with as high an iodin content as Michigan seems to afford.

All of the schools in the four counties were visited by physicians from the Department of Health and a total of 31,612 children were examined for thyroid enlargement.

It was found that as the iodin content decreases the incidence of goiter increases. These records, together with the results of the work in the schools at Akron and Cleveland, furnish quite conclusive evidence that the incidence of goiter can be expected to follow in inverse ratio the amount of iodin available.

Figure 1 shows approximately the quantity distribution of iodin available from water throughout Michigan. In unshaded areas the water available and suitable for public supplies contains no iodin. In the area lightly shaded, from 0 to 2 p.p.b. of iodin are generally found and in the area most heavily shaded from 2 to 5 p.p.b. are found. The dots in the heavily shaded area show locations

of wells which furnished water containing more than 5 p.p.b. iodin. Even in this heavily shaded area an occasional well yielded water containing no iodin.

After these records were published the Michigan Department of Health began searching for some reasonable method for supplying

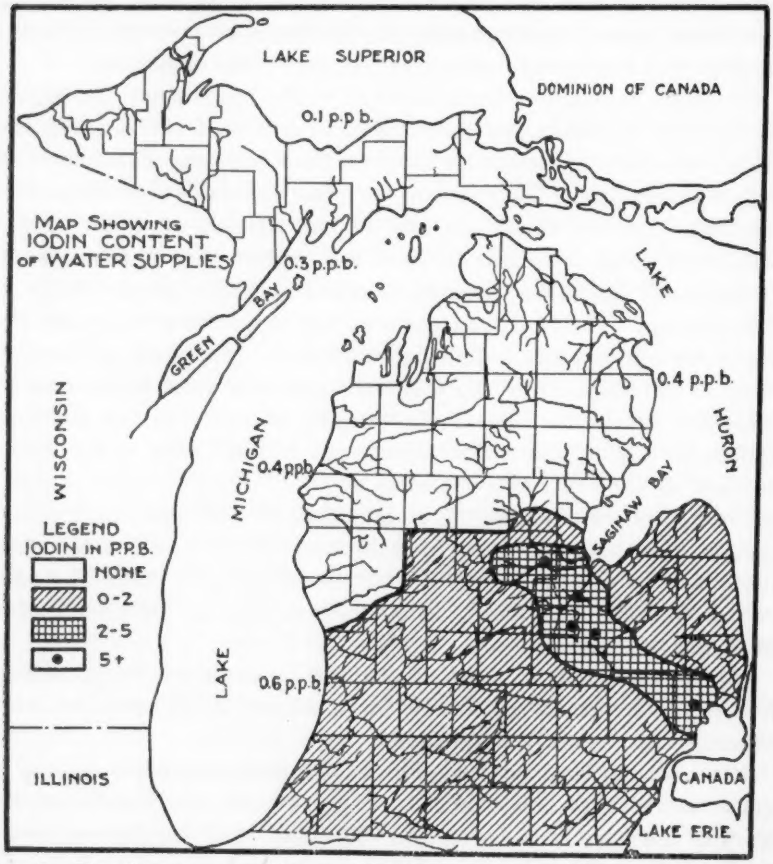

FIG. 1. THE IODIN IN THE GROUND WATER SUPPLIES OF MICHIGAN, SHOWN IN PARTS PER BILLION

No iodin was found in the upper peninsula or the upper part of the lower peninsula. Not all of the supplies examined from the heavily shaded area at the right showed iodin.

the amount of iodin necessary to make up the deficiency. It will be noticed that in Macomb County where the prevalence of goiter was much less than in Houghton County the water samples contained less than 10 p.p.b. of iodin or, if each person drank one liter of water

each day, the iodin consumed from this source would amount to less than 4 mgm. per year. This is supplemented, of course, by iodin from vegetables and other foods, but as the iodin salts are very soluble the amount in vegetables must be almost negligible.

Eminent authorities on the subject of goiter treatment and prevention have stated that 200 to 300 mgm. of iodin should be furnished each person during a period of a year for satisfactory results. It seems reasonable to believe, however, that a much smaller amount would be decidedly beneficial and if 100 mgm. would be sufficient 120 mgm. of sodium iodid would furnish this amount, and in a city using 100 gallons of water per capita per day, only 0.35 p.p.m. of sodium iodid would be required to furnish this amount if each person consumed one quart of water a day. As sodium iodid can be purchased at about $4.00 a pound the per capita cost would amount to only $0.40 per capita per year. During fifteen days of August, 1923, 2 pounds of sodium iodid were added to the water supply of Sault Ste. Marie each day. This amounted to only 0.08 p.p.m. and the per capita consumption of iodin was only about 1.2 mgm. for the period. It is doubtful if this was of any particular benefit.

During the school year of 1922–1923 the schools of many cities of the state provided for all school children chocolate tablets containing iodin. One to three tablets were given each pupil a week. The cost of this treatment amounted to practically the same per person treated as the cost of treating water supplies described above, but more iodin was furnished to each person, as the tablets contained about 10 mgm. of iodin each.

The apparent need for iodin is most marked in young women between the ages of ten and fifteen years, and in pregnant women. The first group can be reached through the treatment in the schools, but persons below and above school age who are badly in need of iodin would also be reached if public water supplies were treated. However, in Michigan about 30 per cent of the population is rural and these people would not be benefited by treatment of public water supplies, if all public supplies could be treated and this would be next to impossible to accomplish.

When water supplies are treated to destroy dangerous contamination, such treatment is for the protection of public health. Public opinion will generally react favorably when properly approached in such measures, but treatment of a water supply with iodin is more in the nature of a benefit to health than health protection and

considerable opposition can be expected when this is attempted. Neither can it be expected that public opinion will always react favorably to the adoption of measures in schools which on the surface appear to be wholesale medications.

A logical method for the general distribution of iodin seems to have been found by having table salt containing iodin placed on the market in grocery stores at a reasonable price. Iodin is an element commonly found with salt and the extensive salt deposits of Michigan generally contain considerable amounts of this element. When crude salt was more commonly used, goiter very probably was much less common, but as sodium iodid is much more soluble in water than sodium chloride, modern methods of making and refining salt lose the iodin in the process of refining.

In the early part of 1924 salt manufacturers of Michigan agreed to produce a table salt containing 0.02 per cent of potassium iodid and place this on the market in 2-pound cartons at $0.15 each. At the present time this salt can be purchased at almost any grocery store in the state and is apparently being very widely used. Thousands of form letters have been sent out from the State Department of Health to people in every walk of life advising the use of this salt for household purposes.

It is believed that the salt method of distributing iodin is more satisfactory than to give it either through the water supply or through tablets to school children for several reasons.

1. Salt is a universal article of food and therefore the iodin in it will reach a greater number of people than if it were administered through either of the other two agencies.

2. Table salt is almost exclusively used as an article of food and therefore there would be less waste of iodin that if given through the public water supply.

3. Salt being a standard article of diet the objection to the giving of medicine is largely removed.

4. Through the agency of salt it is easier to emphasize the food value of a normal amount of iodin without raising the objection to medication.

5. As iodin is a natural constituent of salt as it occurs in the earth the replacement of a small percentage carries more the idea of a return to nature than of a chemical added to a food.

CHARACTERISTIC WATER SUPPLY STRUGGLES IN WEST VIRGINIA CITIES[1]

By E. S. Tisdale[2]

The goal toward which the engineering divisions in all state health departments are striving, is the abolishment of water-borne typhoid fever. The West Virginia State Health Department has been trying, since 1915, to do this and one of the main ways in which the work has been carried on has been by going directly to the city officials and coöperating with them personally, getting a human understanding of their problems and advising with them rather than sitting in the office trying to dictate theoretically what should or should not be done. In these nine years many interesting situations have developed. A glance at them will illustrate the progress achieved since sanitary engineers put their hand to the wheel to reduce the typhoid death rate.

At this time the new Wheeling water purification system has been completed and the citizens are rightly proud of their new plant. For many years Wheeling has been struggling to obtain a pure and safe water supply. Now that the fight for pure water is over I want to point out one of the prices or tributes that has been exacted of the city in the interval when they were seeking a safe water supply.

This fall we had a call from the Health Commissioner of Wheeling to assist him in controlling a typhoid epidemic. We found that a dug well, having a good appearance, as far as exclusion of surface water goes, became heavily polluted with sewage waste during a rainy spell. Eighteen people using the well developed typhoid and six deaths occurred, a death rate of over 33 per cent which is unusually high. By reason of the fact that Wheeling was not furnishing a safe and satisfactory public water supply the lives of these citizens, all of them adults, in their most productive years of life were sacrificed.

[1] Presented before the Central States Section meeting, December 5, 1924.

[2] Director, Sanitary Engineering Division, State Department of Health, Charleston, W. Va.

Only last year we had another similar case in East Fairmont. This city has just completed a new water filtration plant costing about $150,000. This new filtration plant was put into operation Thanksgiving Day. On the first of September an investigation by our department showed a spring in East Fairmont gave the history of causing 50 or 60 cases of typhoid over a five-week period. There was no safe water supply and the people had been driven to use the spring supply. This city was also really responsible for this typhoid outbreak.

The rôle played by chlorination has been of great importance in Fairmont, Wheeling and in Parkersburg during the time necessary for the solving of the water supply problem by the city authorities. It took six years of effort in Fairmont, 1918 to 1924; ten years of struggle in Wheeling, 1915 to 1925; and in Parkersburg the problem is not yet solved. During this time chlorination has to assume necessarily the first and only line of defense against water-borne intestinal disease. Our department has insisted that chlorination be adopted, it be carried on conscientiously and without interruption by the city.

Whereas, typhoid case rates of 200 and 155 respectively prevailed in Wheeling in 1917 and 1918, they were reduced to about 35 in 1919 and 1920. The two cities, Wheeling and Fairmont, have now solved their water supply problems, but Parkersburg is still dependent upon chlorination for protection until a change can be made in the "Smith System" at Parkersburg to revamp it into a mechanical filter plant or adopt some other system for obtaining a satisfactory water supply. Let us examine the water plant records of the Parkersburg plant in 1912 when installed and in 1922, ten years later.

In 1912 no turbidity was detectable at any time and B. coli was entirely absent in 10 cc. for one year's duration. No chlorine was used at this time in the treatment process. The water began to show up badly in 1920 and chlorination was adopted, the beds cleaned and a filter crib built to try and help the Smith filtration system meet the demands of the city.

The 1922–1923 plant records tell of the absolute failure to produce a satisfactory water, a turbidity of 210 was recorded, very muddy water being present five days in August of this year.

Two bond issues to revamp the Parkersburg plant have failed and no funds are available with which to work at the present time. Chlorine is holding the typhoid menace temporarily at bay.

It may be interesting to pause a moment and look back at the sequence of events in Wheeling over a period of ten years. Some of the ways in which a state health department can assist a city are here set forth.

After the failure of the Smith system bond issue in 1915, a well supply investigation was made in 1916, and in 1918, the appointment of a Pure Water Commission came about. At this point, sensing that Wheeling might be many years distant from the safe water supply goal, the Sanitary Engineering Division of the State Health Department took an active part and practically insisted upon chlorination being adopted to reduce water-borne typhoid fever. After much opposition locally, the disinfection apparatus was installed at the city reservoir and here they were destined to operate for six years before finally the pure water supply appeared. In 1919 came the decision of the Pure Water Commission in favor of a mechanical filtration system after competent engineers had studied the local situation and had made their definite recommendation. The one and a half million dollar bond issue urged by the Commission was then defeated.

In 1922 the sanitary engineers of the State Health Department embarked on an educational campaign. Each week a simple story on some phase of water supply and rapid sand filtration appeared in the daily press and gradually when several months had elapsed sentiment was changed in regard to this so-called "chemical" system. However, in 1920 another attempt for a well supply was made by the city authorities and only the insistence by the State Health Department that this type of plant would meet with disapproval by the State Health Commissioner made possible its defeat. Finally, the right combination of affairs arrived. A $2,000,000 bond issue for a modern rapid sand filtration system was passed in 1923 and construction work started.

Even then difficulties arose. During October, 1923, for a time there was danger of an incompetent man being employed to operate the chlorinators which constituted the sole protection on the city water supply just at the time when a serious typhoid epidemic was in free swing a short distance above Wheeling on the Ohio River. However, the trained man was retained and chlorination was regularly carried on at a high rate. Thus, from this brief narrative of events of this ten year struggle for a pure water supply at Wheeling it seems certain that the coöperation with the State Health Department finally brought to Wheeling a pure and satisfactory public water supply.

West Virginia as a state has made tremendous steps forward in the last few years in the water supply field. Elkins has built a 2,000,000 gallon filtration plant; Keyser, in the northern part of the state, has a new 2,000,000 gallon plant; Logan and Bluefield in southern West Virginia have rapid sand filters of 1,000,000 and 2,000,000 gallons capacity, respectively.

These furnish a few examples of the recent filter plant progress. The filter plants are all manned by a capable operating personnel cooperating with our department, by means of a standard report sheet. To keep closely in touch with the smaller communities throughout West Virginia, which have no filter plants and depend upon chlorine disinfection alone, two devices are used, a weekly chlorine report card is filed at the end of each week and our emergency repair service and ortho-tolidin kit service assist in keeping the chlorine treatment rightly proportioned and it helps materially to maintain a definite tie with the department.

One spectacular outbreak of bloody dysentery at Williamson is enough to show, however, that much work still remains to be done in the state of West Virginia in water supply work. Hundreds of people suffered from this terrible disease in July and August, 1924, and several deaths occurred. Since this water plant illustrates to the most extreme degree the principle of exceeding the load which a filter may carry with safety, it is mentioned here.

Factor no. 1. The plant takes its water from wells in Tug River, a stream which is extremely heavily polluted. Investigation showed that the wells are open so that river water passes directly into them. Moreover, several large sewers empty into the river a few hundred feet above the wells, in fact, large sewage sludge deposits have been built up just above the wells in the river, which serves as the intake to the public water supply.

Factor no. 2. In searching for the cause of the dysentery the water plant was immediately suspected. The fact was brought out by investigation that the alum treatment had been discontinued two or three weeks previously to the dysentery outbreak as the supply of chemicals was getting low. Even though chlorine was being used at a high rate this omission of alum treatment indicates incompetency of the plant operators and their total inability to accept the responsibility of operating a filtration plant.

Factor no. 3. The filter plant has practically no sedimentation

basin, a small sump only being provided where the alum is fed into the inflowing water. This sump is really only a mixing chamber.

Factor no. 4. Originally the filter beds were designed as two one-half million gallon units. Now, nearly one and one-half million gallons a day are being forced through these two beds so that they are operating much over their rated capacity.

It is questionable whether the efficiency of 10 per cent which has been tentatively given this plant is not extravagant. Following the detailed investigation of the State Health Department, which set forth clearly that the polluted water was the cause of the wide-spread dysentery outbreak in the city, and the publication of the report, plans have been made for constructing a first-class modern water purification system in Williamson, which is the heart of new and extensive coal fields on Kentucky-West Virginia border.

Nevertheless, summing up the water supply situation over the state as a whole, the outbreak is most encouraging. In the classification of the public supplies of West Virginia in 18 cities over 5000 population, we note that 13 of them with total population of 319,000, are designated as being in Class A, supplying a splendid safe water supply at all times.

Four of these cities, Wheeling, Fairmont, Keyser and Bluefield, with populations of 125,000 people, have made the change from unsafe to safe supplies during 1924. Two cities are given Class B rating, while three more are placed in Class C, unsafe supplies, where the water is considered dangerous to public health.

In closing, I wish to comment upon one more aspect of public water supply contamination, which is coming more and more to the public eye. I have shown how in two instances in Wheeling and Fairmont an unsatisfactory public water supply forced the citizens to use polluted wells and springs located in built-up areas with the consequence of a marked increase in intestinal disease in the community.

Certain public water supplies in West Virginia, Ohio and Pennsylvania are being made unfit for domestic use from the standpoint of tastes and odors due to phenol and other manufacturing wastes entering the streams above the water supply intake. One instance of this is near Fairmont, W. Va. The discharge of such wastes into the streams which make the water supply nauseating, when the phenol-chlorine combination takes place, has a definite effect upon citizens. They are driven to wells and springs for their drinking water supply and it is practically certain that an increase in intestinal disease in the community takes place.

Thus, it is clear that the question of ridding the public water supplies of this part of the country of this new type of pollution is one which the public health authorities must tackle and assist in solving. It is confidently expected that this will be brought about by means of coöperation with the industries involved.

WATER SUPPLY DEVELOPMENT IN SMALL CITIES[1]

By C. M. Ladd[2]

The necessity of an ample and pure supply of water is not open to discussion, but means by which this result may be attained often become the subject of widely diverging opinions.

It is not the purpose of this article to give information of a quantity and quality that will enable the novice to design and build a complete water-works system. It is intended to give only a general idea of the results to be obtained; some of the things to be avoided, as well as done.

First, we would recommend the services of a good, reputable water-works engineer; one who has a good record of service. In many instances the engineer is chosen on price alone; this is an unfortunate condition, and often results in a real calamity to the municipality. When choosing your engineer, make your selection primarily on his ability and reputation, with price the secondary consideration. A good engineer will save money, and, in addition, build a system that will be well designed and constructed, to meet present as well as future needs.

Although you should have a fairly comprehensive idea of the complete system and decide the main scheme or general plan, the details and a great many of the minor construction features should be left directly to the engineer for his decision.

The prime requisites for a general water supply are purity and freedom from excessive hardness and chemicals which tend to make the water undesirable for domestic purposes. Whether the water is taken from a lake, stream or well, the location should be chosen with the idea of avoiding contaminating surface waters. Where surface water is stored and used, it should be filtered, or at least treated with chlorine.

Often the source of the water supply is determined only by its cost. Sometimes the mistaken idea of the municipal authorities, and many

[1] Presented before the joint sessions of the Illinois, Iowa and Wisconsin Sections, March 18, 1925.

[2] Contracting Engineer, Chicago Bridge and Iron Works, Chicago, Ill.

times the lack of the necessary funds to go to the proper supply, control the choice of location. These are unfortunate conditions, as many towns are compelled to use water that is undesirable and dangerous. Our state law makers have seen fit to make nothing but hard and fast laws regarding the handling of public funds. In many cases this is the direct cause of poorly designed and equipped water systems, doing the people a positive injury.

PUMPING EQUIPMENT

There is a type of pump best suited to each condition. Some pumps are better than others. Pumps should be of a recognized make and consideration should be given to their efficiency as well as to their general make-up. This is the era of electricity and when current is available, motor driven pumps can generally be used to the best advantage. Where water comes near enough to the surface to permit the placing of the pump at ground level, or in a pit not more than 20 feet feep, the motor driven turbine pump should be first choice. It also might be desirable to use the triplex gear head at ground level and the cylinder in a pit at a depth not exceeding 25 feet.

In the deeper wells we have the choice of pumps that have single stroke (single stroke, double acting), double stroke or triple stroke. Of these various types, the double stroke seems to be the most popular. The lifting of water from well to a surface reservoir with air pressure is expensive. There are instances where this has been found to be the only satisfactory means of securing water, but under usual conditions it is not considered.

The pumphouse building should be built around the machinery, not the machinery made to fit the building, as is often the case. It should be of substantial construction and of neat appearance; its location will determine to a great extent the amount to be spent for exterior decoration. The interior arrangement should be such that all equipment is easy to operate, with plenty of light and with the idea of making the work as easy as possible for the operator.

STORAGE

Every system should have a tank or reservoir. This tank should be placed at such a height that will give a minimum pressure of fifty pounds in the district to be served. This tank has other useful and saving values in addition to that of storage value. It relieves the

mains of the excessive shocks of the pump and permits the pumps to be run to their full capacity, until the tank is filled, when they may be shut down. The tank permits the pumps to be started and stopped automatically, being controlled by the height of the water in the tank.

The operating records kept in some of the larger cities, where pumping used to be continuous, show that the storage tank has lowered their costs very materially. For all classes of municipalities, and especially the smaller ones, where the amount of water used is small, an all steel elevated tank will serve most advantageously in most cases.

It has been the practice to figure storage at 50 gallons per capita, with a reasonable allowance for growth and a minimum of 30,000 gallons. This minimum has been increased to fifty thousand by a great many engineers and insurance boards. Tanks on 100 foot towers have been the common height throughout the country. Some insurance boards have increased this height to 125 feet. A pressure of 50 pounds gives a fairly satisfactory fire fighting pressure, for average small cities.

Fire protection and insurance are naturally inter-locking. The system should be designed and built so as to secure the minimum insurance rates. You may get a low rate and still not have the maximum protection against fire. Thus you must have both conditions in mind when designing your plant. Your engineer should have, when possible, the rating bureau approve the plans and give in writing your new rates and classification.

PIPE LAYOUT

Pipe layout in the past has received too little consideration as to the sizes and arrangement. The ideal system gives ample water and fire protection to all. It has complete circulation, or, in other words, has no pipe extending out a street without a return. Often this can not be avoided, but when possible the ends should be connected. Valves should be placed so as to cut out the minimum number of users when repairs are being made in any particular section.

It is best to have all lines fed from two or more directions. Also avoid the common error of using pipe which is too small, as the smaller pipe may cost more each year for extra power consumed by friction loss than the additional cost of the larger pipe. If a line is built for present needs only, when increased demands are to be met, trouble and expense will be encountered in the attempt to give satisfactory service.

Be sure that your hydrants are easily accessible and that they will so remain, even during a hard fire. The fire hose should be one of the better known standard brands. It should have a smooth interior, as the friction loss is great in the hose. Your hydrants should not be placed too far apart so that this loss may be reduced and better pressure maintained.

In many systems the layout is such that in case of fire it is necessary to pump direct at pressures varying from 90 to 125 pounds. A great amount of this pressure is consumed in friction loss, caused by pipes being too small and the layout poorly designed. These high pressures cause a great many leaks, both in the mains and in the plumbing. This water waste and the plumbing repairs can and should be avoided by the storage of water at a height that will give a minimum pressure of about 50. This gives a fine domestic pressure and is sufficient for a large percentage of fires.

In municipalities of 3000 or more, there should also be provided a motorized fire pump with a capacity of about 350 gallons per minute. This will be ample for two ordinary fire streams or one large one. With this you save breakage and leaks; also you avoid the use of heavy pipe and at no greater cost when spread over a period of time. In addition you will have had real fire protection.

The meter is important as a saving device. Every user should be metered, whether he gets water free or pays for it. There should be a meter at the pumping station, so that all water going into the mains will be recorded. This checked against the amount metered to consumers will enable you to note the discrepancies, and, when it becomes too great, means can be taken to correct the situation.

BOND ISSUE

One of the greatest sources of delay is occasioned by the faulty actions of councils in taking the necessary steps in the bond proceeding to meet with the laws so that there can be no successful attack made on their legality. This is not the fault of the members of the council and sometimes not of their attorney, but the blame must be laid on them. Your attorney, in a great many cases, has never had charge of drawing up the papers for a bond issue, and until he has had experience, and finds how many places he has not complied with the law, the chances are better than even that a new election will have to be called, or you will not be able to sell the bonds. We do not wish to take any honor from the attorney, but in the smaller towns he is

not the logical man to supervise the steps to be taken. Some engineers may object, and all lawyers will, but it is my belief that all engineers should make themselves familiar with the laws and statues in relation to the issuance of bonds. Then have some high class bond attorney write for them a brief giving in detail every step in its regular order, for towns and cities of various classifications in that particular state. If this were done it would save great delay and in many cases a great deal of money. Your engineer would not get this especially for you, but should have it for the use of his clients and as a part of his regular service.

DISCUSSION

C. M. Baker.[3] One would infer from Mr. Ladd's paper that the air lift method of pumping is not very satisfactory, while on the contrary it is undoubtedly satisfactory under certain conditions. Deep well pumps have been replaced by air lifts in most municipalities of Wisconsin because of less trouble in operation. Although not considered as efficient, they are in many cases more economical because of their simplicity of operation and the fact that such long delays are required in the repair of deep well pumps which frequently require large reserve storage or extra wells.

Pumping by air lift frequently improves the quality of the water by the elimination of iron and objectionable odors. The air reduces the iron to the ferric state, which precipitates to a considerable extent in the receiving reservoir. In many cases Wisconsin waters, objectionable because of iron, have been satisfactory after installation of the air lift method of pumping. Furthermore, waters with objectionable sulphurous odors have been improved materially by this method.

L. R. Howson:[4] The city of Lansing, Michigan, derives its water supply from deep wells. The water was originally drawn from the wells by direct suction, later supplemented in a number of installations by deep well turbine type pumps discharging directly into the distribution system.

Two or three years ago we made an extensive investigation of the best means of providing a water supply for Lansing for the next generation, and in accordance with the recommendations resulting from that investigation we just designed and supervised the construc-

[3] State Board of Health, Madison, Wis.
[4] Consulting Engineer, La Grange, Ill.

tion of an extension to the water supply. This consists of 12 wells averaging about 500 feet in depth and 12 inches in diameter. The wells are spaced at about 300 feet centers. Deep well pumping equipment, motor driven, was compared with an air lift installation. The latter was adopted, its advantages in this case being that it involved lower first cost, operation of the entire group of wells from the one central station, lower annual cost and greater flexibility in operation.

One or two of the outlying wells are still pumped by deep well turbine type pumps.

The water level in the Potsdam sandstone wells in the Chicago area has been receding at a rate averaging from 3 to 5 feet per year over the area. The superintendent at Joliet has stated that the water level in the Joliet wells is receding from 6 to 10 feet per year. In the stockyards region in Chicago the static water level is now over 200 feet below Lake Michigan, whereas some forty years ago the Potsdam wells in this vicinity were in many cases flowing wells.

Outside of the immediate Chicago district the recession of the water level is less pronounced. At Zion City, approximately 45 miles north of Chicago, Potsdam wells still flow at an elevation of 30 to 40 feet above lake level.

This recession of water level has an important bearing on pumping equipment adapted for use in this district. Air lift, being somewhat more flexible than other types of deep well pumps, has been quite largely installed in this district in recent years.

G. C. Habermeyer:[5] The lowering of the water level is due in large part to the pumping of greater quantities of water from wells. It may be that at some wells the water level 20 years ago was 50 feet from the ground surface and that today it is more than 100 feet from the ground surface This is to be expected if the amount of water pumped has increased, the same as we would expect a drop in water level today, if, after pumping during the morning at a rate of 100 gallons a minute, we would increase the rate of pumping to 500 gallons a minute.

There will not be a day on which there is not a failure of the ground water supplies. As the quantity of water pumped from the wells in any area increases and as the water level lowers, it becomes less economical to attempt to secure an increased supply from wells and it may be necessary to be satisfied with the amount obtained.

[5] Civil and Sanitary Engineer, Urbana, Ill.

REPORT OF COMMITTEE NO. 1, ON STANDARD METHODS OF WATER ANALYSIS[1]

Your Committee No. 1, on Standard Methods of Water Analysis, submits a progress report for the year of 1924–1925.

The work of this Committee has been continued along the same lines as in previous years. It has included the dual function of research in chemical and bacteriological water analysis, with the function of coöperation with the corresponding committee of the American Public Health Association in the preparation of the forthcoming edition of Standard Methods of Water Analysis, 1925.

It is not proposed to change the part of the book devoted to the chemical analyses in this edition and the work of your Committee was, therefore, merely an attempt to locate errors or misprints in the current edition, in so far as the chemical methods were concerned.

The bulk of work done by your Committee on the proposed new edition of Standard Methods of Water Analysis was concerned with the bacteriological examination of waters. A considerable number of comments were made by the referees, collected and sent to the American Public Health Association to be considered at their Detroit meeting in October, 1924. Practically all of the suggested changes were approved by the Standards Committee of the American Public Health Association. The material for the bacteriological methods was then put into mimeographed form by the Secretary of the Laboratory Section of the American Public Health Association and copies furnished to your Committee for final revision and comment. As would be expected, most of the matters to be corrected were typographical errors or changes in the phraseology. A conference between the chairman of your Committee No. 1 and the Secretary of the Laboratory Section of the A. P. H. A. enabled most of these points to be corrected. It is the belief of the Committee

[1] Presented before the Louisville Convention, April 28, 1925. Committee No. 1 consists of J. J. Hinman, Jr., Chairman, R. C. Bardwell, J. R. Baylis, J. W. Bugbee, A. M. Buswell, W. M. Clark, H. G. Dunham, N. J. Howard, H. E. Jordan, Max Levine, D. L. Maffitt, M. H. McCrady and F. W. Mohlman.

that material as now prepared is satisfactory as far as our information at this time will permit.

Final approval of the text of the proposed 1925 edition of Standard Methods of Water Analysis by the American Water Works Association is expected at this meeting.

SUMMARY OF THE STATE OF RESEARCH WORK AT THE PRESENT TIME

1. *Rapid Methods of Boiler Water Analysis.*[2] Mr. R. C. Bardwell, referee in charge.

2. *Phenols in Water Supplies.*[3] Dr. A. M. Buswell, referee in charge.

3. *Methods of Determination of Hydrogen Ion Concentration in Bacteriological Media and in Waters.* Dr. William Mansfield Clark, referee in charge.

The work of Dr. Clark has had to do primarily with the influence of various anions upon the precipitation zone of pH and the nature of the aluminum floc.

4. *Dissolved Oxygen and Oxygen Demand.* Dr. F. W. Mohlman, referee in charge.

Dr. Mohlman has devoted his attention this year primarily to the brilliant green lactose bile media in coöperation with Mr. McCrady. An article by Dr. Mohlman entitled Sewage Analysis and its Interpretations, appeared in the American Journal of Public Health, Vol. 15, No. 1, 10–16 (January, 1925). In this article Dr. Mohlman had endeavored to show the present status of the determination of biochemical oxygen demand.

5. *Determination of Free Carbon Dioxide in Water.* Mr. Dale L. Maffitt, referee in charge.

Experimental work on a rapid colorimetric method for the determination of free carbon dioxide has not yielded the results hoped for. A method depending on the use of dimethyl aniline has been studied.

6. *Nitrogen Determinations.* Mr. J. W. Bugbee, referee in charge.

Correspondence on the subject indicated to the referee that a large number of laboratory workers consider the nitrogen determinations to be in satisfactory shape. With Mr. Bugbee's consent

[2] Printed for discussion in JOURNAL, August, 1925, page 107.

[3] This JOURNAL, page 348.

his assignment was therefore changed to the study of the condition of the methods for the determination of lead, copper and zinc.

7. *Microscopic Examination of Water for Algae. Determination of Turbidity and Coefficient of Settling.* Mr. John R. Baylis, referee, in charge.

Mr. Baylis submitted a report on the microscopic examination of water. Mr. Baylis advocates the use of a standard volume for estimating the quantity of larger microscopic organisms instead of, or admitted as co-standard with, the present standard unit of area.

8. *Lactose Fermenting Spore Forming Bacteria and their Significance.* Mr. Norman J. Howard, referee in charge.

9. *The Use of Eosine Methylene Blue Agar.*[4] Dr. Max Levine, referee in charge.

10. *The Use of Brilliant Green Lactose Bile Medium.*[5] Mr. MacHarvey McCrady, referee in charge.

Those who have assisted the referee in his work are:

Associates, 1923

F. E. Hale, Director, Mount Prospect Laboratory, Brooklyn, N. Y.
C. R. Cox, Chief Chemist, Filtration Plant, Reading, Pa.
F. H. Stover, Chemist, Filtration Plant, Louisville, Ky.
W. D. Hatfield, Supt. Filt. Plant, Highland Park, Mich.
C. Burdick, Chief Chemist, Filtration Plant, Flint, Mich.
H. E. Jordan, San. Engr., Indianapolis Water Co., Indianapolis, Ind.
H. G. Dunham, Dir. Bact. Lab., Digestive Ferments Co., Detroit, Mich.
N. J. Howard, Bacteriologist, Filtration Plant, Toronto, Ont.
C. J. Lauter, Chief Chemist, Filtration Plant, Washington, D. C.
M. H. McCrady, Chem.-Asst. Bact., Prov. Board of Health, Montreal.

Associates, 1924

H. W. Clark, Dir. Expt. Station, Lawrence, Mass.
H. G. Dunham, Dir. Bact. Lab., Digestive Ferments Co., Detroit, Mich.
C. J. Lauter, Chief Chemist, Filtration Plant, Washington, D. C.
C. H. Burdick, Chief Chemist, Filtration Plant, Flint, Mich.
A. H. Strauss, Dir. Lab., State Dept. Health, Richmond, Va.
C. D. Howard, Chief, Div. Chem. and San., State Board of Hlth., Concord, N. H.
J. H. Rider, Director State Lab., Tucson, Ariz.
W. M. Wallace, Filt. Supt.-Chief Chem., Detroit, Mich.
D. L. Maffitt, Chief Chemist, Water Works, Des Moines, Ia.
Frank Raab, Chief Chem.-Bact., Filt. Plant, Minneapolis, Minn.

[4] JOURNAL, September, 1925, page 267.
[5] To be published in a later issue of the JOURNAL.

P. Boynton, Chemist, Filtration Plant, Clarksburg, W. Va.
J. W. Kellogg, Bact., State Lab. Hygiene, Raleigh, N. C.
G. F. Gilkinson, Chief Chemist, Water Dept. Kansas City, Mo.
J. W. Bugbee, City Chemist, Providence, R. I.
G. E. Willcomb, Chem., Div. Water Sewage Treat., Albany, N. Y.
M. H. McCrady, Chem-Asst. Bact., Prov. Bureau Hlth., Montreal.
C. C. Ruchoft, Bact., San. Dist., Chicago, Ill.

11. *The Use of Gentian Violet Lactose Broth.*[5] Mr. Harry E. Jordan, referee in charge.

12. *Selection and Use of Dyes in Bacteriological Culture Media.*[6] Mr. H. G. Dunham, referee in charge.

GENERAL RECOMMENDATIONS

Your Committee No. 1 would recommend that the present relation of the Committee to the corresponding Committee of the American Public Health Association be maintained, and that every effort possible be made to strengthen the spirit of coöperation between the two organizations. Greater participation in succeeding editions of Standard Methods of Water Analysis should be expected.

In regard to the conduct of the research work of the Committee it is recommended.

1. That the Committee be continued and that the chairman be empowered to appoint sub-chairmen for the bacteriological and chemical sub-divisions of the general committee.

2. That the work on rapid standard methods for boiler water analysis be continued in the effort to fix the best methods and practice, and that, if permission from the American Railway Engineering Association can be obtained, the present standards of that organization for rapid boiler water analysis as prepared by our referee, be printed as a tentative matter in the Manual.

3. That work on the detection of phenols in water supplies be carried forward and information collected concerning tastes from chlorphenols together with the effect of superchlorination in destroying such tastes.

4. That the methods for pH and for alkalinity be further studied, as well as alteration in current practice to allow the use of methyl red or another indicator with an endpoint near 5.5 pH and to be included in the standard procedure.

5. That the determination of dissolved oxygen and biochemical oxygen demand be further studied, especially in reference to their country-wide use.

6. That the study of the determination of free carbon dioxide be continued.

7. That the methods for lead, copper and zinc, including the Hanford-Bartow method be studied, as to limitations and accuracy.

8. That an attempt to learn the value of a unit of standard volume in laboratories over the country be made, so that the desirability of its inclusion in Standard Methods of Water Analysis may be estimated.

9. That an attempt be made to correlate work on very low turbidities and coefficient of settling throughout the country.

10. That the study of the spore-forming lactose-fermenting bacteria be continued.

11. That the attempt to simplify the use of eosine methylene blue agar be continued.

12. That the study of brilliant green lactose bile as primary and as secondary fermentation medium be continued.

13. That the study of gentian violet be continued.

14. That the study of the action of dyes in culture media and of the methods of selection of proper dyes for such use be continued.

15. That such other need for improvement of analytical procedures as may come to the attention of the committee may be given such attention as is required, either by the appointment of interested personnel or by the change in assignment of members of the committee as constituted.

BIBLIOGRAPHY ON THE DETECTION OF PHENOLS IN WATER SUPPLIES[1]

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   The addition of uranium acetate or nitrate to a phenol solution produces a red color.
2. Bach, H. 1912 Kolorimetrische Bestimmung von Phenolen in Abwassern. (Colorimetric determination of phenols in waste waters.) Z. Anal. Chem., **50,** 736-40.
   Millon's reagent and nitric acid gives a color with phenol. The best results are obtained when the quantity of phenol is between 30 and 150 mgm. per liter.
3. Bell, W. H. 1921 A method for the detection of phenols produced by bacteria. Jour. Infectious Diseases, 29, 424-8.
   Diazotized p-nitroaniline in alkaline solution was used for the detection of phenols in dilutions as great as 1 p.p.m.
4. Bertholet, A., and Michel, M. 1919 (Use of aromatic sulfo-chloramides as reagents.) Bull. Sci. Pharmacol., **26,** 401-7.
   Chloramine T gives characteristic colorations with certain phenolic substances in dilutions as great as 1:50,000.
5. Bezssonow, N. 1921 Simplified method of preparation of the Bezssonov reagent for vitamin C and some polyphenols. Biochem. Jour., **17,** 420-1.
   Directions are given for the preparation of the phosphomolybdotungstic acid reagent.
6. Bezssonov, N. 1922 (Color reactions of antiscorbutic extracts and of polyphenols with a phosphomolybdotungstic acid.) Bull. Soc. Chim. Biol., **4,** 83-95.
   Notes on the color reactions of phosphomolybdotungstic acid with phenols.
7. Bezssonov, N. 1924 (The reaction proposed by Jendrassik (1923) to characterize vitamin B and its relation with the phenol function.) Bull. Soc. Chim. Biol., **6,** 35-9.
   For ortho and para-phenols the reduction of $K_3Fe(CN)_6$ in the presence of $FeCl_3$ with the formation of Prussian blue is a very sensitive reaction.

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[1] A list of selected Journal articles on methods for the detection of phenols, with particular reference to their possible application to the analysis of public water supplies. Contribution to Report of Committee No. 1, on Standard Methods of Water Analysis.

Prepared by C. F. Schurch, Assistant Chemist, State Water Survey Division, Urbana, Ill., for A. M. Buswell, referee on detection of phenols, Committee No. 1.

8. Chapin, R. M. 1920 Diazometric titration of phenol and certain of its homologs. Jour. Ind. Eng. Chem., **12**, 568–70.
A method for the titration of phenol with diazo solution.

9. Dehn, W. M., and Scott, S. F. 1908 Some characteristic color reactions produced by sodium hypobromite. Jour. Amer. Chem. Soc., **30**, 1418–23.
Certain phenolic and aromatic amino compounds give characteristic color reactions with sodium hydobromite solution.

10. Donaldson, W. 1921 Detection of phenols in water. Jour. Ind. Eng. Chem., **13**, 848.
A correction to R. D. Scott's paper.

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The authors state that the only specific qualitative test is the chlorine taste test.

12. Escaïch, A. 1920 Recherche du phenol ordinaire et de l'aniline. (Detection of phenol and aniline.) J. Pharm. Chim., **22**, 140–1.
When a dilute phenol solution is treated with NH_4OH, $Na_2S_2O_8$ and $AgNO_3$ a characteristic color is produced.

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A tabulation of the color reactions of various acids with phenols in the presence of H_2SO_4.

14. Folin, O., and Denis, W. 1921 Phosphotungstic-phosphomolybdic compounds as color reagents. Jour. Biol. Chem., **12**, 239–43.
Directions are given for the preparation of the Folin and Denis reagent. The delicacy of this reagent toward tyrosine is said to be 1 part in 1 million.

15. Formanek, J., and Knop, J. 1917 Uber den Nachweis der Phenole auf spektroskopischem Wege. (Spectroscopic indentification of phenols.) Z. Anal. Chem., **56**, 273–98.
A critical reinvestigation of the work of Gsell on the differentiation of phenols by means of absorption spectra.

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A description of the absorption spectra of the phthaleins of 20 phenols. A method is offered for the differentiation of the phenols.

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Arsenotungstic acid produces a blue color with certain phenols.

18. Guglialmelli, L. 1916 (Arsenotungstomolybdic acid as a reagent for phenols.) Anales Soc. Quim. Argentina, **4**, 183–4.
Arsenotungstomolybdic acid gives color reactions with all phenols except those with no free phenol group.

19. Guglialmelli, L. 1917 (General method for detection of phenols in essential oils.) Anales Soc. Quim. Argentina, **5**, 11–23.
Arsenotungstic and arsenotungstomolybdic acids give color reactions with free phenol OH.

20. Hanke, M. T., and Kressler, K. K. 1920 Quantitative colorimetric determination of tyrosine and tyramine and other phenols. Jour. Biol. Chem., **41**, (3) XLIX.

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22. Levine, V. E. 1920 New color reaction for phenols based upon the use of selenious acid. Science, **52**, 207.

Phenols in contact with sodium selenite in concentrated H_2SO_4 give a blue or green color reaction.

23. Levine, V. E. 1920 The action of proteins on the phenol reagent of Folin and Denis. Science, **52**, 612–3.

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The article states that 1 p.p.m. of phenol can be detected by means of the color produced by p-nitroaniline base, sodium acetate and $NaNO_2$.

25. Newman, T. C. 1919 Synthesis or organic derivatives. Can. Chem. Jour., **4**, 47–8.

The action of H_3AsO_4 upon phenols is considered.

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Color reactions for certain cerium salts and various phenols are discussed.

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Color tests for phenols are of little value unless the colors produced are subjected to critical analysis by the spectroscope.

28. Parry, Walter 1923 (A color reaction for phenols.) Ciorn. Farm. Chim., **72**, 245–55.

Mandelin's reagent (a vanadate plus concentrated H_2SO_4) gives color reactions with phenol.)

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Formaldehyde and other aldehydes in the presence of H_2SO_4 give characteristic colors with phenols.

30. Rodillon, G. 1921 Sur une nouvelle reaction specifique de l'acide phenique. (Specific reaction for phenol.) Jour. Pharm. Chim., (7) **23**, 136–7.

The addition of H_2SO_4 to a phenol solution containing a drop of $NaNO_2$ produces a colored ring.

31. Rose, J. H., and Speer, F. W. 1920 Determination of phenols in ammonia still wastes. Amer. Gas. Assoc. Monthly, **2**, 117–20.

Bromine water produces a precipitate or turbidity with phenols in dilutions as great as 1:50,000.

32. Scott, R. D. 1921 Detection of phenols in water. Jour. Ind. Eng. Chem., **13**, 422.

The method consists in distilling the water under examination with acid and testing the distillate with the Folin and Denis reagent.

33. Sieburg, E. 1916 Zur Kenntnis der Formaldehyd-Schwelelsaure Reaktion. (Formaldehyde-sulfuric acid reaction.) Biochem. Z., **74**, 371–5. Furfaldehyde and formalydehyde unite with phenols in the presence of H_2SO_4 to form colored addition products.

34. Skirrow, F. W. 1908 Determination of phenols in gas liquors. Jour. Soc. Chem. Ind., **27**, 58.

A method is offered for determining phenols by means of the addition of iodine solution and back-titration with $Na_2S_2O_3$.

RECONSTRUCTION OF FILTERS AT LOUISVILLE[1]

By W. H. Lovejoy[2]

The Louisville filtration plant contains two separate batteries of filter units, one of which failed in many respects to function properly during the past ten years.

The first battery of six 6½-million-gallon units was completed and started in 1909. These original beds, although not being of the most modern design, having steel walls and bottoms throughout, have nevertheless been in continuous and successful operation ever since and are still running.

In 1914 a second battery of twelve 3-million-gallon units was built in the north half of the filter house, which had been left for that purpose in the original building construction. Soon after starting these latter beds certain weaknesses began to show up that were due to features that were overlooked in both the design and the equipment. After running these units for two or three years under the constant burden of frequent breakdowns and repairs, we finally were forced to let them lie idle and keep only a part of the units ready for service to help out the old filters in case of peak loads. This was the situation up to about a year ago, when our normal and peak loads had increased to such a point that we were forced to start preparations to put these north filters into shape for more dependable use.

At this point it may be helpful for the sake of clearness to give a brief description of the layout of the whole plant. The river pumping station, capacity 112 m.g.d., pumps through 5 force mains, 2½ miles long, under a head of 168 feet and discharges into the storage and settling reservoirs. There are two of these reservoirs, each having a capacity of 55 million gallons. These basins are operated in series, giving about three days subsidence period at the present rate of 40 m.g.d. consumption in the city.

From the reservoirs the settled water flows by gravity to the coagulating basins, of which there are two having capacities of 4 and 8

[1]Presented before the Louisville Convention, April 28, 1925.

[2]Superintendent of Filtration, Louisville, Ky.

m.g. From the coagulating basins the coagulated water flows to the filter house. The filter house is 390 by 110 feet in plan and is built over the easterly section of the clear well.

CAUSES OF FILTER FAILURES

The principal causes of the failure of these units, and those which we attempted to remedy by reconstruction as best we could under the existing conditions, may be summed up as follows:

1. A crowded pipe gallery, for 8 by 10 feet was altogether too small properly to accommodate piping and valves. There was no walking space or head-room in the gallery and one had literally to crawl over and around piping to get through it. For this reason the adjustment and repair of valves in this gallery was anything but a pleasant job and was in some cases all but impossible.

If, in the original design, 2 feet had been added on each side of this gallery, it would have added 50 per cent to the area and width of it and would have sacrificed only 4.0 per cent of the total filtering area or less than half of one filter unit, at the same time making plenty of room in the gallery for proper setting of piping and valves and for walking space besides.

This trouble was much improved in reconstruction by rearranging piping and valves, taking the 36-inch influent pipe out of the gallery altogether and raising the 20-inch washwater line so as to give head-room. The 36-inch influent pipe was replaced by two-30-inch pipes running along inside the filter walls, with the 20-inch inlet valves placed vertically in the front of each unit.

2. The operating floor was also too narrow and cut-up with twelve operating tables and five 5 by 10 feet openings into the gallery with hand-rails around them.

This feature was improved by placing a new 3-inch concrete slab on I-beams with Hy-Rib reinforcement. The operating floor is now 15 feet wide with six 8 by 12 feet openings over the gallery, the openings being covered with subway grating. This gives a very roomy operating floor and the removable gratings make it easy to get at pipe and valves in the gallery for repairs.

3. Another bothersome feature, which was remedied soon after starting these beds, was the fact that the wash troughs were set too high above the sand, the distance from trough weir to sand surface being originally 35 inches. This caused excessive wash water usage (from 4 to 5 per cent) and gave incomplete washing even at that rate.

This was soon corrected by lowering the troughs to a distance of 24 inches, which cut the wash water to 2 per cent and gave better washing. The end walls of the filters next to the sewer forebay were left too low, allowing a certain amount of longitudinal motion to the water while washing and thus spoiling the lateral travel toward the troughs for some distance back in the filter. These walls were raised 2 inches and an improved lateral travel was obtained in washing.

4. All valves on these units were too light for the service and the motors driving them were too light and insufficiently insulated. The absence of a dependable and positive limit-switch control caused motors to overrun, jam and break many valve stems. Valves were at first fitted with brass stems and the brass stems proved, by frequent bending and breaking, to be the weakest part in the valve assembly. Then we put in steel stems and the motors began burning out, the steel stems holding up under the strain better than the motors.

Another trouble with the valves in some cases was due to improper setting. The wash water and influent valves were set at bad angles without proper provision in the way of guides and rollers to allow proper working in the angular setting.

The valve troubles were all overcome in the revamping by replacing all old electrically-operated valves with new hydraulic valves, all new valves being set in a vertical position.

5. The effluent controllers had a habit of sticking and were set in such a position that they could not be taken apart for repairs. The adjusting nut of the controller was connected to the operating table by means of three shafts and two sets of gears. The lost motion in these gears amounted to more than half of the total throw of adjustment on the controller. Needless to say, this was not a very effective method of adjusting the rate.

These old controllers were replaced with new venturi type controllers with automatic pilot valve control from the operating table. These controllers had to be specially designed with a short tube to fit into the space available for them.

By the time we started reconstruction work on these filters our water consumption had risen so high that we could not afford to tear up all of this battery at one time. For this reason the work was complicated by having to arrange to leave half of the battery ready for service in emergency while the other half was being refitted. This method of carrying out the work required the cutting and plugging of

the inlet and wash water headers between the two halves and practically refitting six of the units ready for emergency operation before the other six were dismantled.

The reconstruction work consisted of the dismantling of the old operating tables and equipment, removing all of the operating floor slab, removing all the old piping and valves in the gallery, raising the 20-inch wash water header 3 feet, replacing the 36-inch inlet header with two 30-inch headers placed inside the filter walls, raising the two 36-inch inlet header valves and replacing all old valves with new hydraulic valves. Then the new floor slab was placed and the operating tables re-erected with new tops and new gauges and control equipment.

The most difficult and tedious part of the work consisted of making the many cuts and replacements in the concrete walls of the filters and in the thick floor of the gallery. Twelve 20-inch inlet wall pieces had to be cut out and the openings concreted. Six 24-inch sewer wall pieces had to be cut out and concreted. Fourteen 3 by 3 feet cuts were made in 14-inch filter walls to receive the new 30-inch inlet headers. Twelve 3 by 6 feet cuts were made in the groined arch floor of the gallery, averaging 2 feet thick, to remove the old controllers and insert the new ones. Practically all of this cutting work was done with jack-hammers and was done in fairly quick time. All old lead pipe joints were burned out and all cast iron pipe was cut with the oxygen-acetylene burner. Most of the new joints were poured with leadite.

Practically all of this reconstruction work was done within five months after the material was on the ground at a cost of $60,000. The original installation cost $180,000 in 1914.

Besides the reconstruction of the filters proper, there was also a new 48-inch line laid in addition to and paralleling the old 48-inch line running from the settling basins to the filter house with new connections to and from the coagulating basins to increase the available supply between the basins and filters. This was made necessary by the fact that we had outgrown the capacity of one 48-inch line between these points and on several occasions found it neccessary to by-pass the coagulating basins and run directly off from the settling basins to obtain sufficient water for the filters by utilizing the higher head available from the settling basins. This arrangement was made possible by using one of the two settling basins as a coagulating basin.

In the last four or five years we have not only overtopped the capacity of pipe lines between basins and filters, but quite a few times we have also run very short on filter capacity, due to the fact that the North Filter units were so unreliable. At such times we had to resort to several inadvisable, but necessary, innovations. One of these was that of converting one or two filters units into "speed" beds as it might be termed. By this is meant the operation of a bed for short periods at excessively high rates of filtration to tide us over high peak loads. This was done either by bracing the controller open or, as in one case, by removing the controller altogether and rating the bed by the effluent valve only. Another method of increasing the rate is to use a shallow sand bed of only eight or ten inches in depth.

Of course, such methods as these are not advisable under any but very extraordinary conditions of emergency and were only done at times when water conditions were favorable bacterially and were done with very great care.

However, in the last analysis, all of these makeshifts and innovations had to be resorted to as a direct result of the absence in our filter units of the prime requisites of accessibility, flexibility and dependability in design and equipment, and these are the points which we attempted to obtain in the reconstruction work.

AN INEXPENSIVE AUTOCLAVE FOR SMALL LABORATORIES[1]

By E. E. Wolfe[2]

The Board of Public Works of this city found it necessary to establish a temporary laboratory for the bacteriological examination of its water supply. An autoclave for the sterilization of culture media was of course needed, but not wishing to purchase an expensive apparatus, the outfit described below was utilized with success.

A 25-quart "Denver" pressure cooker was obtained from a chemical supply house. This cooker is cast in heavy aluminum, is well constructed, of neat appearance, and is easily manipulated. Its cover is equipped with an $\frac{1}{8}$-inch air-cock, a 30 pound pressure gauge and a safety valve designed to blow at 30 pounds gauge pressure.

The safety valve is of a familiar type, consisting of a steel ball seated in a brass cup, held in place by a small cross arm fastened by two spiral springs of 30 pound tension. The blow-off pressure of this type of valve is of course not easily regulated. Since it is desirable to maintain a pressure of 15 pounds per square inch for the sterilization of culture media, and to have a means of adjustment to other pressures, if necessary, a small change was made in the safety valve, as described in the following:

The springs and cross arm were removed. In place of one spring was put a rigid bar soldered to the spring-holder nearest the cover. A slot was cut in the upper end of this piece, and to this was fastened loosely a cross arm of longer length than the original, making a lever, the union of the two bars being a fulcrum. A sliding weight, about 12 ounces, made from a brass cup filled with lead, was attached to the projecting end of the lever which had been notched.

The changes made are shown in figure 1.

[1] Presented before the Iowa Section meeting, November 6, 1924.

[2] Chemist, Board of Public Works, Hannibal, Mo.

By adjusting the position of the weight, various blow-off pressures can be obtained. The effect is similar to that given by the safety valve on the "National" sterilizers.

The cost of this sterilizer was about thirty-five dollars.

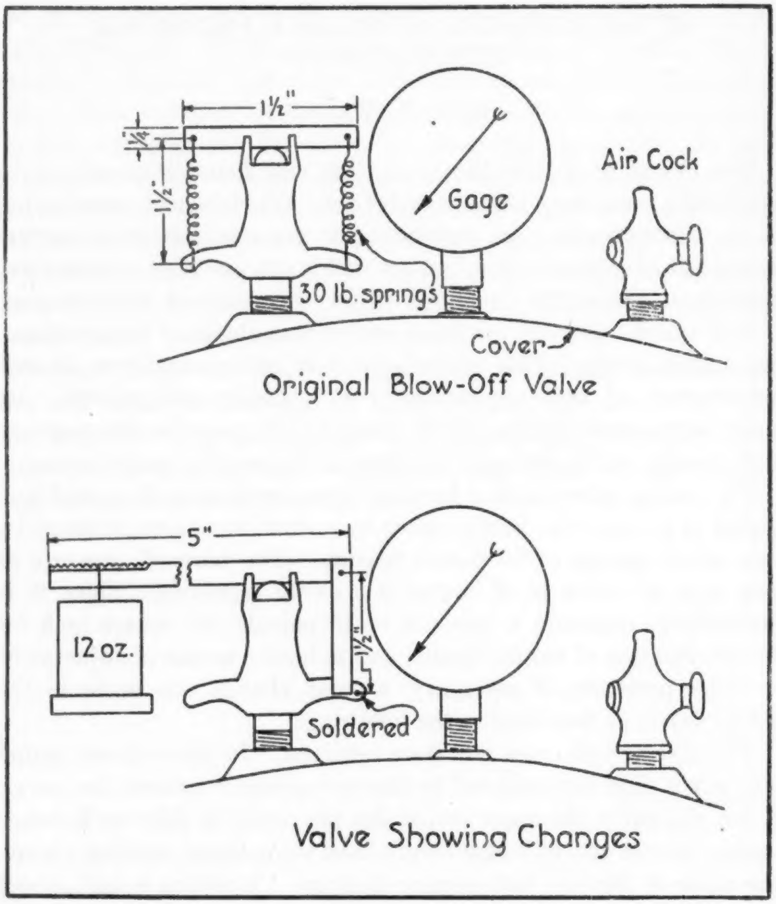

FIG. 1

ABSTRACTS OF WATER WORKS LITERATURE

FRANK HANNAN

Key: American Journal of Public Health, 12: 1, 16, January, 1922. The figure 12 refers to the volume, 1 to the number of the issue, and 16 to the page of the Journal.

Water Treatment on the Chicago and Alton Railroad. L. O. GANDERSON. Railway Review, 75: 571–16, 1925. Partial treatment with soda ash only was started in practically all water tanks on the C. & A. R. R. in 1922. Results have been considered satisfactory and it is estimated that an annual saving of $325,294 is being made on a $50,000 investment at an expense of $29,170. The soda ash solution is proportioned automatically from diaphragm divided drums by holding a back pressure of about 3 pounds. The foaming tendency of the treated water with its precipitated sludge is avoided by blowing locomotives sufficiently often to prevent concentration of alkali salts from exceeding 145.5 gr. per gallon between water changes or washouts. A net saving in fuel is claimed despite large amount of hot water wasted. Regular treatment and careful supervision are considered necessary to insure successful results.—*R. C. Bardwell.* (*Courtesy Chem. Abst.*)

Cleaning Water Mains Yields Large Returns. CHARLES HAYDOCK. Railway Maintenance Engr., 20: 359–12, 1924. Tuberculation reduces carrying capacity of cast iron pipe lines much more rapidly than commonly appreciated. The Pennsylvania Water Companies scrape over 20 miles yearly. Cleaning soft, muddy deposit from 12,438 feet of 10-inch cast iron pipe increased yield half million gallons per day or approximately 56 per cent. Length of life of beneficial results not definitely established. Cleaning is not considered true remedy for the condition of loss of carrying capacity of pipe and recommendation is made to determine and remove cause of incrustations.—*R. C. Bardwell.* (*Courtesy Chem. Abst.*)

Union Pacific Water Improvement Work Proves Profitable. ANON. Rwy. Engr. and Maintenance, 20: 380–10, 1924. Article gives a complete history of development of water treatment improvement and organization on the Union Pacific Railroad. Water improvement was largely responsible for permitting long locomotive runs which have been made up to 1984 miles. In 1904 there were 35 treating plants in operation which decreased to 15 in 1916 due to lack of proper attention. This has since been increased to 33 plants and supplemented by changing source at many points to secure better quality. Expenditures for improvements amounted to $1,089,000, of which $500,000 has been for water conditioning. The net saving exceeds $200,000 annually.

Mileage of flues and fireboxes has been very materially increased and pitting reduced. The organization consists of 4 traveling chemists who report to the Consulting Chemist and work in conjunction with the main laboratory at Omaha. Charts showing hardness of water and descriptive photographs are given.—*R. C. Bardwell.* (*Courtesy Chem. Abst.*)

Rock Island Studies Effect of Winter on Water Softening. ANON. Railway Engr. and Maintenance, **21**: 54–2, 1925. Difficulty was encountered in reducing scale forming solids in continuous type lime soda softening plant during cold weather, without leaving water in condition to cause foaming in locomotive boilers. Results on Des Moines River water at Estherville, Iowa, at 33°F. show raw water 38 to 42 gr. per gallon total hardness with Alk. 21.5 to 23, and treated water 3.5 to 6.0 hardness with 8.5 to 11.0 alk. Foaming trouble caused hardness of treated water to be raised to 8 and 9. Remedy suggested was heating water. (Note: Trouble could have been stopped by lowering soda ash overtreatment and raising lime. R. C. B.)—*R. C. Bardwell.* (*Courtesy Chem. Abst.*)

Railway Water Supplies for Drinking Purposes. ANON. Railway Review, **76**: 519–11, 1925. Reprint of Report by American Railway Engineering Association Water Service Committee on Protection of Small Well Supplies for Drinking Purposes.—*R. C. Bardwell.* (*Courtesy Chem. Abst.*)

A Comprehensive Water Supply Program. J. W. PORTER. Ry. Rev., **76**: 217–5, 1924. Due to unsatisfactory quality and limited quantity in shallow and deep wells, it was necessary for the Canadian National Railways to install 24 impounding reservoirs, holding 1,371,000,000 imp. gallons, at a cost of $1,692,000 from 1921 to 1923 inclusive on their lines through Western Canada. Most dams were of earth construction with sheet piling or puddled core wall. Riprap spillways were not a success and were replaced with concrete. Interesting features of two reservoirs was foul water ditch to eliminate bad water drainage. Photographs and general discussion of conditions are given.—*R. C. Bardwell.* (*Courtesy Chem. Abst.*)

Protection of Small Water Supplies Used by Railroads. Com. Rep. Amer. Ry. Engr., Assn., Bul. 270, 131–26, 1924. Largely reprint of recommendations on shallow small water supplies by O. E. Brownell of Min. State B. of H. together with sketches showing proper protection for pump installations.—*R. C. Bardwell.* (*Courtesy Chem. Abst.*)

Pennsylvania Constructs Large Dam to Insure Water Supply. CHARLES HAYDOCK. Ry. Engr. and Maintenance, **21**: 139–4, 1925. Completion of dam at Tipton, Pa., holding 355,000,000 gallons, practically doubles storage capacity in Altoona District. In addition to cut off trench, cement grout was forced in all crevices and drill holes which assisted in perfecting bond. Above ground line the exposed faces were built of rubble masonry. Pipe lines through face of dam were 24-feet and 36-inch diameter. Spillway is located in center, 150 feet long and 4 feet below rest of dam. Meter is provided in Gate

house for recording amount of water used from this supply.—*R. C. Bardwell.* (*Courtesy Chem. Abst.*)

The Cost of Impurities in Locomotive Water Supply and Value of Water Treatment. Com. Rep., Amer. Ry. Engr. Assn., Bul. 272, 380–26, 1924. Records and reports indicate a saving of $1647 per locomotive per year with partial treatment on moderately hard waters (12 to 15 gr. per gallon), and as high as $4132 per locomotive on waters of 25 and over, due to elimination of scaling matter before water goes to boilers. Results on several railroads are given in detail.—*R. C. Bardwell.* (*Courtesy Chem. Abst.*)

Pitting and Corrosion of Boiler Tubes and Sheets. Com. Rep., Amer. Ry. Engr. Assn., Bul. 272, 377–26, 1924. Investigation to date confirms the electrochemical theory, with rate of corrosion influenced by H-ion conc. Experiments conducted for years indicate most effective remedy is overtreatment with NaOH. Recommended formula for excess to be carried.

$$\frac{\text{Gr. per gal. } Na_2SO_4 + \text{gr. per gal. } NaCl}{10} + X$$

In this formula X is variable for constants other than Na_2SO_4 and NaCl. For distilled water X becomes 5. In presence of carbonates or hydrates of Ca and Mg it can be disregarded. Test is now being run on counter-electrical method of preventing corrosion in practical application.—*R. C. Bardwell.* (*Courtesy Chem. Abst.*)

Chicago Sanitary District Issued Permit to Divert 8500 Second-Feet. Eng. News-Rec., **94**: 448–50, March 12, 1925. Text of 5-year permit granted by War Dept. covering diversion of water from Lake Michigan by Sanitary District of Chicago given. The permit allows the diversion of 8500 second-feet, the instantaneous maximum not to exceed 11,000 second-feet, in addition to that drawn by Chicago for water supply, which in 1924 was 1200 second-feet. The conditions of the permit require that a program of sewage treatment by artificial processes be carried out which will provide equivalent of complete (100 per cent) treatment of sewage of population of at least 1,200,000 before expiration of permit, and also the adoption within 6 months of a program for metering 90 per cent of Chicago's water service, with meter installations of 10 per cent per annum. It is believed that the above program will relieve the load on the drainage canal to such an extent that a reduction to 7250 second-feet, or less may be possible by 1929, with view to reduction to 4167 second-feet by 1935.—*R. E. Thompson.*

Loss of Head in Closely Baffled Mixing Basin. C. W. Smedberg. Eng. News-Rec., **94**: 476, March 19, 1925. Loss of head and corresponding coefficient C are shown graphically for various rates of flow through closely baffled mixing basin of the "around the end" type which forms part of new 6-m.g.d. filtration plant at Greensboro, N. C. Brief description and illustration of basin included.—*R. E. Thompson.*

How the Mississippi River is Regulated. CHAS. L. POTTER. Eng. News-Rec., **94:** 508–14, March 26; 556–9, April 2, 1925. Historical review and outline of methods employed in improvement and control of Mississippi River. The Mississippi River Commission's policy of "levees only" for flood control below Cairo is defended, and other methods often advanced—spillways, reservoirs, reforestation, and contour plowing—discussed.—*R. E. Thompson.*

Effect of Deforestation on Runoff in Mississippi Basin and Flood Prevention. Eng. News-Rec., **94:** 826, May 14, 1925. Discussion of paper by C. L. Potter (cf. preceding abstract) by R. W. Davenport and by E. C. Pratt.—*R. E. Thompson.*

Roller Gates Make up the Major Portion of Powerdale Dam. J. E. YATES. Eng. News-Rec., **94:** 482–3, March 19, 1925. Brief illustrated description of Pacific Power and Light Company, dam on Hood River, major portion of which consists of rolling crest gates with sills practically at stream bed level, facilitating removal of large amount of sand and gravel carried down by the river. —*R. E. Thompson.*

World's Largest Rock-Fill Dam Built on Dix River. GEO. W. HOWSON. Eng. News-Rec., **94:** 548–52, April 2, 1925. Construction of Dix River dam, 1020 feet in length and 20 and 275 feet in width and height at crest, respectively, described.—*R. E. Thompson.*

Dam Floods Danville Water Works. PAUL HANSEN. Eng. News-Rec., **94:** 636–7, April 16, 1925. Construction of dam on Dix River by Kentucky Hydro-Electric Company (cf. previous abstract) has increased depth of water 50 feet at site of Danville water works, necessitating construction of new works, cost of which was paid by the Hydro-Electric Company. The old plant was located in the Dix River valley, the purified water being pumped approximately 4 miles to city. The new purification plant, consisting of coagulation basins and rapid sand filters, together with adequate storage, has been constructed near the city and the water will be drawn from the river by means of pump shaft designed to operate with water level variations of up to 70 feet, and pumped through original pipeline to plant.—*R. E. Thompson.*

Building a High Reservoir Wall of Reinforced Concrete. Eng. News-Rec., **94:** 590–4, April 9, 1925. Construction of concrete reservoir 400 feet square and 30 feet deep for water supply of Eastern Hills suburb of Cincinnati, Ohio, described in some detail.—*R. E. Thompson.*

Los Angeles Plans 268-Mile Aqueduct from Colorado River. Eng. News-Rec., **94:** 560, April 2, 1925. Brief details of proposed 268-mile aqueduct for conveying water from Colorado River to Los Angeles given. The water will be drawn from gravel beds which are situated between the bank of the river and the Maria mountains and which constitute an infiltration gallery into which, it is believed, there will be a constant flow of silt-free water. The total lift necessary is 1416 feet exclusive of friction head, and either 5 or 6

pumping stations are favored as economic number. Cost is estimated at $100,000,000-$150,000,000.—*R. E. Thompson.*

Effect of Flowing Water on the Stability of Sand. C. M. Daily. Eng. News-Rec., **94**: 649, April 16, 1925. Effect of flowing water on sand is discussed in relation to maintenance of stability of permeable dikes and cofferdams and in jetting of piles.—*R. E. Thompson.*

Oil Tank Fails After Sudden Drop in Temperature. Eng. News-Rec., **94**: 638–9, April 16, 1925. Fire destroyed 2 oil tanks of Maryland Refining Company, Ponca City, Okla., on December 19, apparently originating through ignition of escaping oil after rupture of one tank. A long period of mild weather preceded the accident, and a sharp drop in temperature from 60°F. to −4° occurred immediately prior. The main break in lower ring of shell, believed to be starting point of rupture, was clean break, practically square to length of plating, located about 6 feet from vertical joint, and at or near joint in curb angle. According to best information there was no atmospheric disturbance on day of accident, no loud report indicating any considerable explosion, and no defective welding or insufficient or improper riveting involved. The accident was possibly direct result of sharp drop in temperature causing contraction of shell while oil in interior and plating of bottom were still at temperature of not much below 60°.—*R. E. Thompson.*

Sacramento Filter Plant Report Advises Extensive Repairs. Eng. News-Rec., **94**: 639, April 16, 1925. Report of H. D. Dewell recommends repairs to existing plant at cost of $100,000, rendered necessary by extensive cracking and settlement due to faulty design, and construction of bank of 8 new filters at estimated cost of $330,000. Extent of settlement is uncertain on account of faulty records. Maximum in structures on piles may be as much as 6 inches, and in those on spread footings possibly 1 foot. If further settlement does not occur, the plant, which is functioning satisfactorily after 1 year's operation, will probably give satisfactory service for many years. The repairs will be carried out immediately but construction of new filters will not be considered for at least some time.—*R. E. Thompson.*

High-Velocity Discharge of Overfall Dams and Forms of Spillway Profile. Adolph F. Meyer. Eng. News-Rec., **94**: 597–9, April 9, 1925. Ogee form of spillway profile is shown to be wrong, producing eddying at foot of apron and scour of stream bed for considerable distance. In the form of spillway recommended the solid curved bucket is replaced by hollow bucket designed to destroy quickly excess energy in overfalling water, and to force the water to assume a downstream direction of flow throughout full depth of natural stream within short distance of toe of dam.—*R. E. Thompson.*

Scour Below Dam Prevented by Special Toe Construction. James H. Pirie. Eng. News-Rec., **94**: 780, May 7, 1925. Dam constructed according to principles outlined by A. F. Meyer (cf. preceding abstract), for Landreth Production Company, across Hubbard Creek near Ibex, Tex., has been in service since

1923 and loose gravel in front of toe shows no sign of scour. Brief details and illustration of dam included.—*R. E. Thompson.*

Preventing Dam Undercutting. Eng. News-Rec., **94**: 866, May 21, 1925. Discussion of article by A. F. Meyer (cf. preceding abstracts) by Geo. W. Jeffery and by M. Suquet.—*R. E. Thompson.*

Brass Services and Special Goosenecks Used by Hackensack Water Company. D. W. French. Eng. News-Rec., **94**: 653–4, April 16, 1925. Brass pipe has been used for approximately 3 years by Hackensack Water Company, for ¾ to 1-inch services, and cast iron for larger services. The first brass pipe obtained was brittle and non-flexible, and broke transversely. Semi-annealed pipe has been specified since that time and has proven satisfactory. Brass pipe is not as cheap as lead-lined galvanized iron, galvanized iron, or black iron, but is considerably cheaper than lead. Lead goosenecks with wiped joints, in use until present year, were found to be generally unsatisfactory and cup joints have been substituted with excellent results and with reduction of $.80 each in cost of production.—*R. E. Thompson.*

Experience with Wood-Grating in Sacramento Filters. Harry N. Jenks. Eng. News-Rec., **94**: 634–5, April 16, 1925. Experience with wood-grating underdrains is outlined and certain disadvantages described. It has been found that due to relatively low resistance any inequality in static head throughout system has correspondingly greater effect in producing uneven washing of filter, as compared with performance of perforated-pipe laterals. Another difficulty experienced was liberation of dissolved oxygen which collected under false bottom and escaped from time to time in single mass causing disruption of filter gravel. Use of 3-inch layer of cemented gravel was experimented with in one filter to remedy this condition but the thickness employed was insufficient and several blow holes developed. Cemented gravel layer of 8 inches would probably give desired strength, but it remains to be proved whether even this combination can excel perforated-pipe underdrains for dependability under all operating conditions in respect to production and maintenance of uniform back-wash throughout filter bed.—*R. E. Thompson.*

Garza Dam for Dallas Water Works Will Impound 63 Billion Gallons. Eng. News-Rec., **94**: 630–3, April 16, 1925. Illustrated description of construction of hydraulic-fill dam across Elm Fork of Trinity River near town of Garza, 26 miles northwest of city, forming reservoir of 63 billion gallons capacity. Existing storage capacity of 7 billion gallons, impounded in 5 reservoirs, largest of which has capacity of 5.5 billion gallons, serves present population of 225,000, and it is estimated that the additional storage capacity will serve 3 to 5 times that number of people.—*R. E. Thompson.*

Plugging a High Pressure Tunnel, Buffalo Filtration Plant. C. S. Rindsfoos. Eng. News-Rec., **94**: 641–3, April 16, 1925. Plugging of high pressure tunnel, 80 feet below ground and 66 feet below lake level, and sinking of new shaft pneumatically, described and illustrated.—*R. E. Thompson.*

Electrically-Welded Steel Pipeline for Vallejo (Calif.) Water Works. Eng. News-Rec., **94:** 654–5, April 16, 1925. Contract has been let for 22 miles of 22- and 24-inch electrically-welded steel pipe which is to convey water from Gordon Valley, where new storage reservoir is being constructed, to city distribution system. Guaranteed efficiency of electrically-welded pipe was 10 per cent higher than for rivetted steel pipe and costs 10 per cent lower, effecting saving of approximately $40,000 on work of which total cost will be $450,000. The manufacturers have placed themselves under $200,000 surety bond guaranteeing the pipe for 5 years against all leaks and other defects due to faulty material, manufacture, or installation, and agreeing to make good or replace any such defects without cost to city. Longitudinal seams are guaranteed to 80 per cent of full strength of plate used ($\frac{5}{16}$ and $\frac{1}{4}$ inch) and circumferential seams to 40 per cent. All angles are to be made in field and no single angle is to be more than 10°. Pipe lengths will be immersed in "Californian Asphaltum" at 400°F. for 10 to 15 minutes, drained, and while still hot wrapped spirally with a "mica covering" previously impregnated with "a high boiling point bituminous compound containing not less than 25 per cent by weight of alkali-resisting mineral." The impregnated covering must not weigh less than 3.6 pounds per square yard. Hot asphaltum will be applied between pipe and covering as wrapping is carried out to increase thickness of coating and to seal the joints, the flake mica will be applied where surplus asphaltum escapes. Life of pipe is estimated at 35 to 40 years. The pipe will be subjected to head of 400 feet for one-third of length and minimum head throughout will be 100 feet.—*R. E. Thompson.*

Standard Report Sheets for Small Filters. Eng. News-Rec., **94:** 654, April 16, 1925. Reproduction of standard report sheet prepared by Harry F. Ferguson to assist smaller plants in Illinois in keeping daily records in order that comparable monthly reports may be made to State Board of Health.—*R. E. Thompson.*

Progress of St. Louis' New Water Works on the Missouri. Eng. News-Rec., **94:** 633, April 16, 1925. Points of interest in connection with new works briefly described. Extensive works for controlling and diverting flow of river, probably most elaborate ever attempted in municipal water works construction, will be completed next year. Variation in water level is 35 feet.—*R. E. Thompson.*

Fire Hose Forms Seal for Stop Logs to Unwater Intake Chamber. J. E. Gibson. Eng. News-Rec., **94:** 651–2, April 16, 1925. In unwatering new intake chamber to connect new intake pipe at Charleston, S. C., it was found impossible to properly seal the stop logs provided for the purpose, leakage around the ends being in excess of capacity of ejectors. The difficulty was finally overcome by making joint between the logs and concrete by means of fire hose under water pressure equal to 45 foot head, care being taken not to exceed this pressure in order that hose would not act as hydraulic jack.—*R. E. Thompson.*

Users Advance Money for Small-Town Water Extensions. JENT G. THORNE. Eng. News-Rec., **94**: 653, April 16, 1925. Town of Low Moor, Ia., being confronted with necessity of providing more water mains after legal means of increasing town's bond issue were exhausted, appealed to interested property owners for aid. Majority of owners subscribed $100 each and a few larger amounts, credit being granted by the town on future water bills at regular rate. Five blocks of water mains were laid and financed in this manner. Petitions are now in circulation for further extensions by same method.—*R. E. Thompson.*

How a Town of 10,000 Revamped Its Water Works. H. A. TOLBURG. Eng. News-Rec., **94**: 656–8, April 16, 1925. New water works in Monmouth, Ill., consists of 2 drilled wells 2445 feet deep, pumping equipment, and reinforced-concrete covered reservoir. Joints in 18-inch cast iron well casing used in lining top 488 feet were brazed, it having been found that such joints would hold in excess of 78 tons. The over-all efficiency of the old pumping plant was only 17 per cent. The total cost of the plant was $112,860, and it is expected that bond issue of $90,000 will be retired within period of 7 years as excessive water rate of $.60 per 1000 gallons, considered justified under the conditions, will provide surplus of $19,850 per year.—*R. E. Thompson.*

Water District and Power Company Adjust Differences. ARTHUR L. SHAW. Eng. News-Rec., **94**: 660, April 16, 1925. Agreement has been reached between Kennebec Water District at Waterville and the Central Maine Power Company, re-development of power on Messalonskee Stream, whereby the former receives from the power company, without charge, power equivalent to that which the district might have developed for pumping water from Chena Lake, 8.4 miles distant, had there been no interference by company's development.—*R. E. Thompson.*

Double-Acting Trench Force Pump. Eng. News-Rec., **94**: 669, April 16, 1925. Double-acting trench force pump manufactured by Domestic Engine and Pump Company, which may be used where discharge must be pumped to considerable height, described briefly and illustrated. Construction of pump, allowing direct flow of material across lower end of pump cylinder, makes possible handling of water containing very large percentage of sand or other foreign matter without danger of the material building up in pump chamber. —*R. E. Thompson.*

Securing Harmony in Operation of Filter Plants. C. A. BROWN. Engr. and Contr., **62**: 1057–60, 1924. Respective shortcomings of mechanical and chemical operators are discussed and need for coöperation pointed out.—*C. C. Ruchoft.*

Modern Methods of Building Water Works Reservoirs. R. E. McDONNELL. Engr. and Contr., **62**: 1061–65, 1924. Advantages and some construction features of large reserve reservoirs.—*C. C. Ruchoft.*

Use of Soda Ash for Preventing Corrosion. M. C. Whipple. Engr. and Contr., **62**: 1065–66, 1924. Effluent of filter plant at Cambridge, Mass., had pH 6.1 to 6.2, with 7–8 p.p.m. of CO_2 and caused corrosion trouble. This was corrected by adding 80 to 140 pounds of soda per million gallons, increasing pH to 6.6 to 6.9, at cost of $1.30 to $2.30 per million gallons. Soda was found in this case preferable to the less expensive lime as it reduced the hardness and prevented formation of hard scale in boilers.—*C. C. Ruchoft.* (*Courtesy Chem. Abst.*)

Purification of Trade Wastes. H. Kessener. Eng. and Contr., **62**: 1067–70, 1924. Experiments on purification of wastes of beet sugar, strawboard, and potato flour plants by means of septic tanks and percolating filters and of activated sludge treatment.—*C. C. Ruchoft.* (*Courtesy Chem. Abst.*)

Reinforced Concrete Pressure Pipe for Water Supply. F. F. Longley. Engr. and Contr., **62**: 1071–76, 1924. Description of methods of constructing poured, centrifugal, and cylinder lock joint pipe.—*C. C. Ruchoft.*

Meterage Effects Saving in London, Ont. E. V. Buchanan. Engr. and Contr., **62**: 1087–88, 1924. With installation of 4944 meters during first seven months in 1924, saving of 185 imp. gallons per meter per day over entire period was effected.—*C. C. Ruchoft.*

Paint Causes Taste and Odor Troubles. W. S. Mahlie. Engr. and Contr., **62**: 1089, 1924. Southwest Water Works Journal. Melting of paint in newly painted standpipe when water was at a low level caused taste and odor.—*C. C. Ruchoft.*

Iron Removal Plant at Griffin, Ga. E. S. Chase. Engr. and Contr., **62**: 1090, 1924. J. Soc. Chem. Ind., **44**: 518. Deep well water supply of 1 m.g.d., containing 0.2 to 2 p.p.m. of iron is satisfactorily treated in plant consisting of coke prefilters, settling basins, and rapid sand filters.—*C. C. Ruchoft.*

Hydraulics of House Plumbing. Anon. Engr. and Contr., **62**: 1077–78, 1924. Conclusions from tests of various diameters, lengths, and arrangements of pipes, traps, and vents used in house plumbing.—*C. C. Ruchoft.*

Cost of Water at Topeka, Kansas. Anon. Engr. and Contr., **62**: 1297, 1924. Average cost in 1923 was $15.82 per million gallons for chemicals and salaries. —*C. C. Ruchoft.*

An English Concrete Water Tower. L. J. Pond. Engr. and Contr., **63**: 90, 1925. Method of constructing 60,000 gallon thin section water tower is described.—*C. C. Ruchoft.*

Lining Reservoir with Paving Brick. Anon. Engr. and Contr., **63**: 124, 1925. The method of lining a concrete reservoir which had been leaking at the joints, with paving brick is described.—*C. C. Ruchoft.*

Identification of Fresh Water Algae. I. M. Lewis. Engr. and Contr., 61: 802-3, 1924. General summary of common forms.—*Langdon Pearse.* (*Courtesy Chem. Abst.*)

Ditch Digging Machines. Mr. Garvin. Penna. W. W. Assn., 1924 Report. Page 116. Last week we operated machine under fairly favorable conditions in some sandy soil, some gravel and some rotten shale. Trench was 20 inches wide and 5 feet deep. Cost was 3¼c per foot.—*E. E. Bankson.*

The Marketing of Water Company Securities. Farley Gannett. Penna. W. W. Assn., 1924 Report. Page 125. Discussion on "How to get the money" for water works construction.—*E. E. Bankson.*

The Mental Attitude of the Consumer to the Utility Which Serves Him. George S. Davison. Penna. W. W. Assn., 1924 Report. Page 146. Detailed account of twenty-year struggle to obtain rights for water service which would provide fair return. Remarkable and humorous.—*E. E. Bankson.*

Public Relations. P. H. Gadsden. Penna. W. W. Assn., 1924 Report. Page 158. Interesting discussion, with plea for full publicity and no secrets by public utility.—*E. E. Bankson.*

Decisions of the Courts and the Pennsylvania Public Service Commission During the Year, Affecting Water Companies. Edward Munson. Penna. W. W. Assn., 1924 Report. Page 183. Review of decisions and findings in Pennsylvania for current year, including index to subjects and cases covered. —*E. E. Bankson.*

The Pollution Problem. Joseph A. Beck. Penna. W. W. Assn., 1924 Report. Page 236. The Indian case relates principally, to pollution caused by coal mine drainage. Ever since final decision in Sanderson Coal Company case (113 Pa. 126) in 1886, it has been generally thought that water companies could not object to pollution of their sources of supply by coal mine drainage, on theory that such pollution resulted from natural forces without any fault of coal operator. Doctrine of Sanderson case has been expressly refuted by courts of county jurisdictions and now also by Supreme Court of Pennsylvania in Indian Creek case with conclusion: "That defendants have no right of any kind to drain their mine waters into the stream, considering the public use which is made of its waters and that their so doing constitutes a nuisance which must be restrained." Riparian owner below cannot be required to protect himself. In some of federal cases there is an indication that court will not enjoin pollution where harm done by injunction would be greater than benefit derived therefrom, but this doctrine has no application where public rights are involved. Each water company holds its source of supply in trust for its consuming public and it must perform its duty in its trusteeship. A water company should not sleep on its rights in this regard because, if trespasser pollute a stream for over 21 years, he obtains a prescriptive right so to do, but he cannot pollute the water to any greater extent than it was polluted

at the commencement of the 21 years and there can be no prescriptive right acquired to maintain a public nuisance.—*E. E. Bankson.*

Recent Development in the Use of High Pressure and Super-heated Steam. B. M. Broido. Proc. Eng. Soc. Western Pennsylvania, **40:** 9, 299, December, 1924. Development of steam engine has been constant struggle to increase working pressures. A few years ago we arrived at a figure of about 250 pounds per square inch. About three years ago tests were published of an experimental plant with pressures up to 900 pounds. Now we have plants operating at 1200 pounds in the United States and at 1500 pounds per square inch in Sweden.—*E. E. Bankson.*

Higher Terminal Results in the Boiler Room and the Relation Between Efficiency and Economic Values. Joseph G. Worker. Proc. Eng. Soc. Western Pennsylvania, **41:** 2, 33, March, 1925. Valuable discussion of mechanical stokers, including performance curves and tables.—*E. E. Bankson.*